Electronic Technology Training Course

Chapter 5
and

debugging of TV principle

Chapter 5 Principle Analysis, Assembly and Debugging of ZX2035 5.5- inch Black and White TV

This machine uses a large-scale single-chip black-and-white TV integrated circuit CD515CP (abbreviated as CD5151) with peripheral components. Since CD5151 integrates all small signal processing circuits, there are few peripheral components and debugging

is relatively simple. It is suitable as the first choice for students and enthusiasts to learn, weld and debug electronic equipment.

5.1 Main parameters of ZX2035

This machine can use two power supply methods, one is AC mains, the input voltage is ~220V , 50HZ , after voltage reduction, rectification, filtering, and voltage stabilization, the output

Output 9~12V DC stable voltage, which can be adjusted to Rated output 10.8V . Another power supply method is to directly use a DC power supply, which requires a DC input of 12V , and then supply power to the entire machine after passing through a DC voltage stabilizing circuit.

The whole machine working current is 0.8~1.2A , and the power consumption is about 10 Watts, antenna input impedance is 75Ω , video input impedance is 75Ω, image clarity is greater than 380 lines. Audio output power is greater than 0.5 watts.

5.2 Schematic diagram of the ZX2035 black and white TV

When dealing with a more complex electronic device, it is generally necessary to first divide the schematic diagram of the entire machine into several parts, and then divide each part into several small units. The method of breaking the large into small and the whole into zeros is

adopted. First, the unit circuit analysis is performed, and then the overall synthesis is performed, so as to achieve the purpose of understanding and mastering the working principle of the whole machine.

According to the general principle block diagram of black and white TV, combined with

The specific circuit of the ZX2035 black-and-white TV can be obtained as shown in Figure 5-1 . According to the block diagram, its working process is:

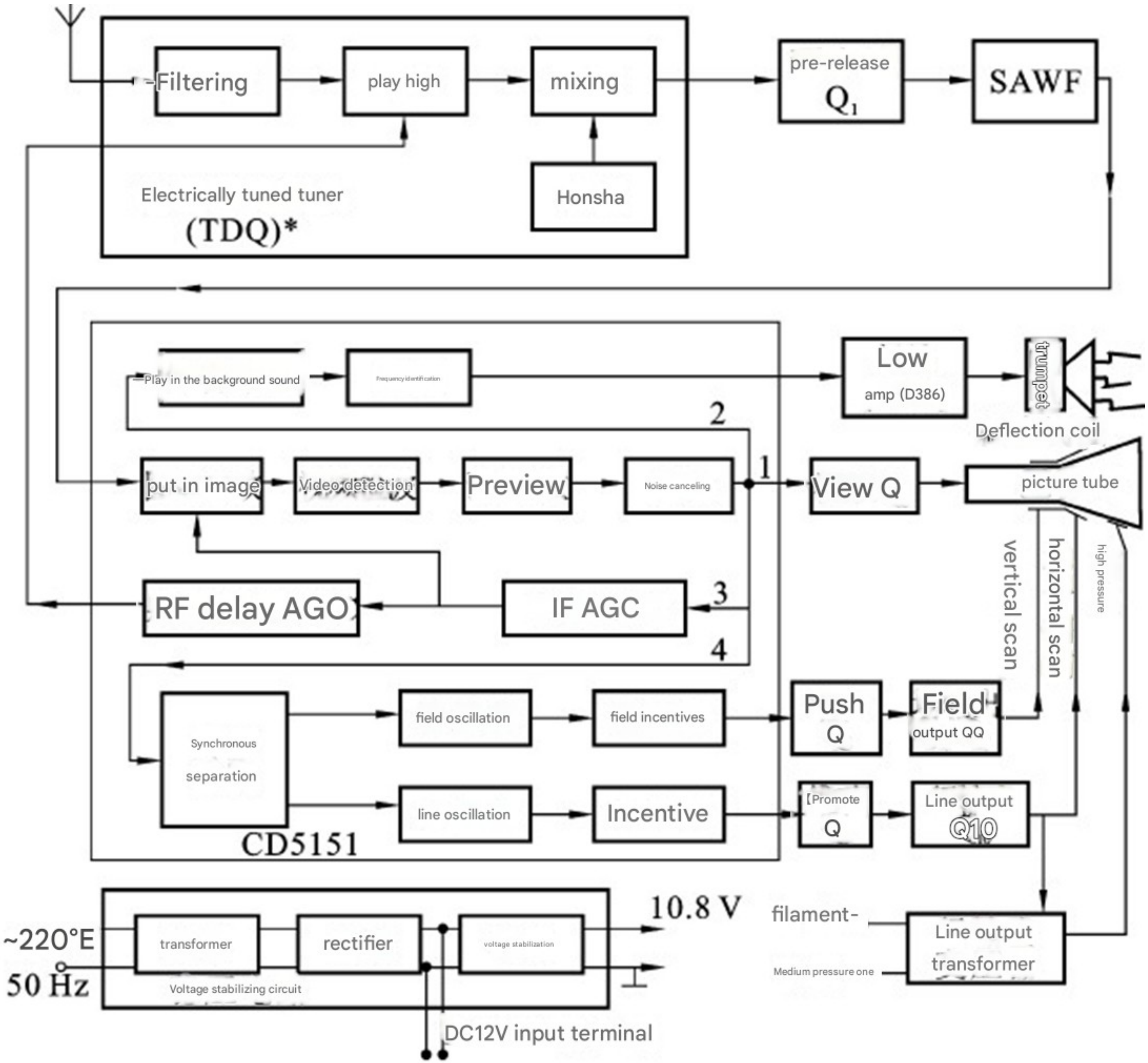


Figure 5-1 Principle block diagram of ZX2035 black and white TV

The following is a brief description. The RF full television signal with different carrier

frequencies received by the antenna, Whether it is the 49.75MHz band of Meterwave l , Or decimeter

wave
band V

951.25MHz , after the electronic tuning high frequency head tunes the station, high frequency

After amplification and frequency conversion, it becomes a 38MHz intermediate frequency full television signal. The signal is first amplified by the pre-amplifier (Q1), and then filtered by the surface acoustic wave

filter before entering the image intermediate frequency amplifier circuit. The image intermediate frequency amplifier has the functions of amplification and filtering. The signal released from the image passes through the video detector to obtain an image signal with a frequency

range of 0 to 6MHz and various synchronous blanking signals, and also obtains a second audio intermediate frequency signal of 6.5MHz . These signals are collectively referred to as video signals. The first video signal passes through the pre-amplifier and noise elimination circuit, and then

passes through the video amplifier.

After the amplifier further amplifies the signal and reaches the specified amplitude, it is sent to the display.

The cathode of the tube controls the change of cathode potential, thereby restoring a black and white image on the screen of the picture tube. Since the control grid of the picture tube is grounded, the video signal sent to the cathode of the picture tube must

be a negative polarity image signal. The higher the level, the darker the image .

The signal coming out of the noise cancellation circuit is divided into four paths.

As mentioned above, the video amplifier further amplifies the second channel, and the second channel is sent to the audio

amplifier. The function of the audio amplifier is to convert the second channel of the video signal into

The intermediate frequency signal of the accompanying sound is selected and amplified, and then the amplified signal is taken out by the frequency detector.

The third channel is used to control the gain of the image intermediate frequency amplifier after passing through the intermediate frequency AGC circuit. At the same time, part of

the signal needs to pass through the radio frequency delay AGC circuit to control the gain of the high frequency amplifier. The function of the third channel signal is negative feedback control, which can make the quality of TV images and accompanying sound more stable and clear. The fourth

channel is sent to the synchronization separation circuit to separate the line field synchronization signal in order to control the line field oscillation circuit of the TV and the line field synchronization of the transmitter.

The output of the field excitation stage of the internal circuit of the integrated circuit CD5151

is further amplified by the external

transistor Q5 to drive the field output

stage circuit composed of two

transistors Q6 and Q7 to generate a

vertical scanning signal and send it to

the field deflection coil placed in the neck of the

picture tube to control the vertical deflection of the electron beam. Similar to the above, the line scanning signal output by the line excitation is further amplified by Q9 , which drives the line output tube Q10 to generate a horizontal scanning signal and send it to the line

deflection coil. At the same time, the retrace pulse of the line scanning signal also generates the anode high voltage, filament voltage, and various voltages required by the picture tube through the line output transformer.

The medium voltage of the focusing electrodes is used to supply them with power.

In addition, the row scan output circuit also plays the role of a secondary power supply.

It should be noted that the

block diagram only shows

In addition to the flow of major signals, there are still several feedback signal paths that are not given. These will be described in detail when the entire electromechanical

schematic is explained.

5.3 Internal circuit structure diagram and pin function diagram of CD5151

In the ZX2035 black-and-white TV, the large-scale integrated circuit CD5151 occupies an important core position. It completes all small signal processing and the formation of line and field scanning signals. Therefore, it is very necessary to understand its

internal circuit structure (see Figure 5-2) and pin functions (see Figure 5-3). Mastering the DC potential and ground resistance value of each pin of CD5151 under normal circumstances (see Table 5-1) is of great reference value for technicians who assemble, debug and repair the TV .

About the functions of CD5151 internal circuit and the role of each pin

This has been mentioned in the previous section and will be further elaborated in the subsequent sections.

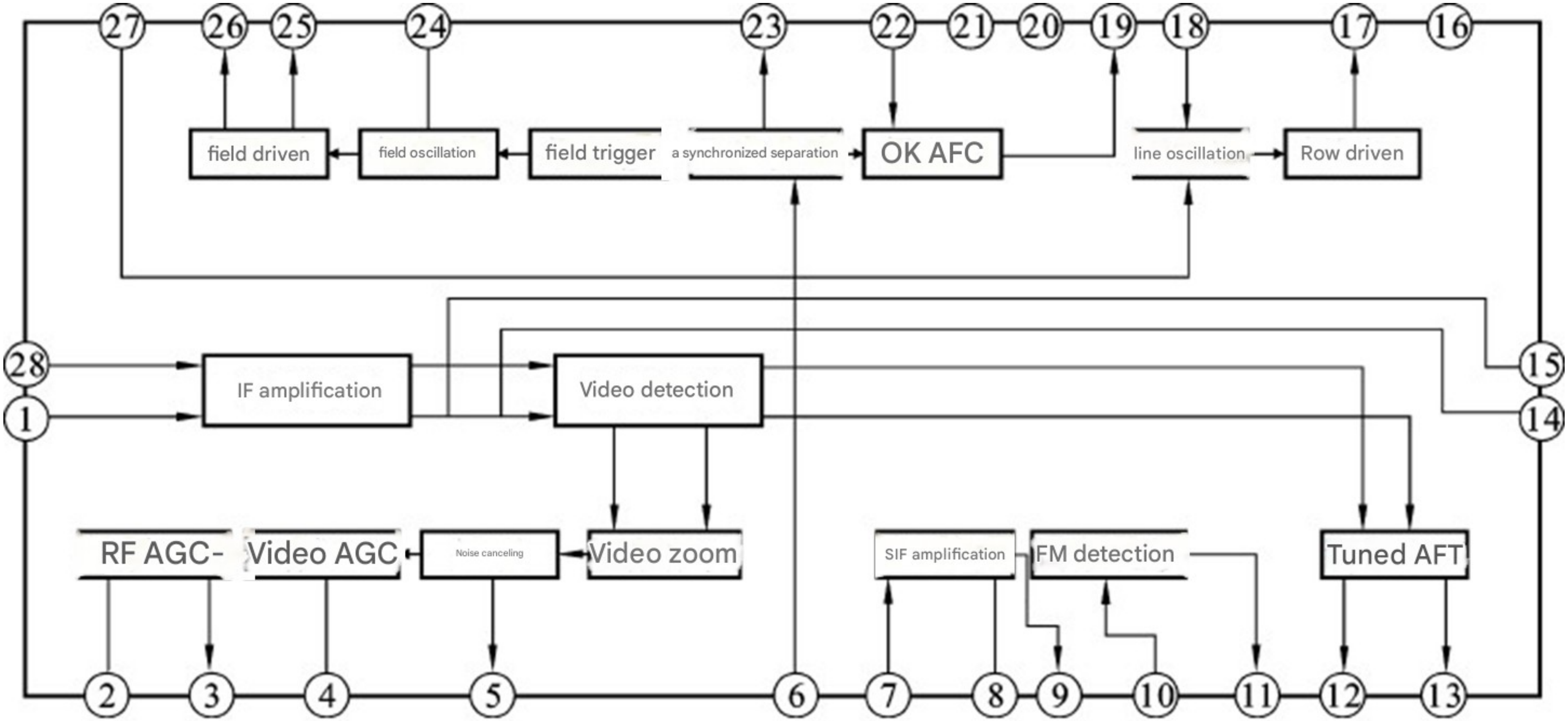


Figure 5-2 CD5151 internal circuit structure block diagram

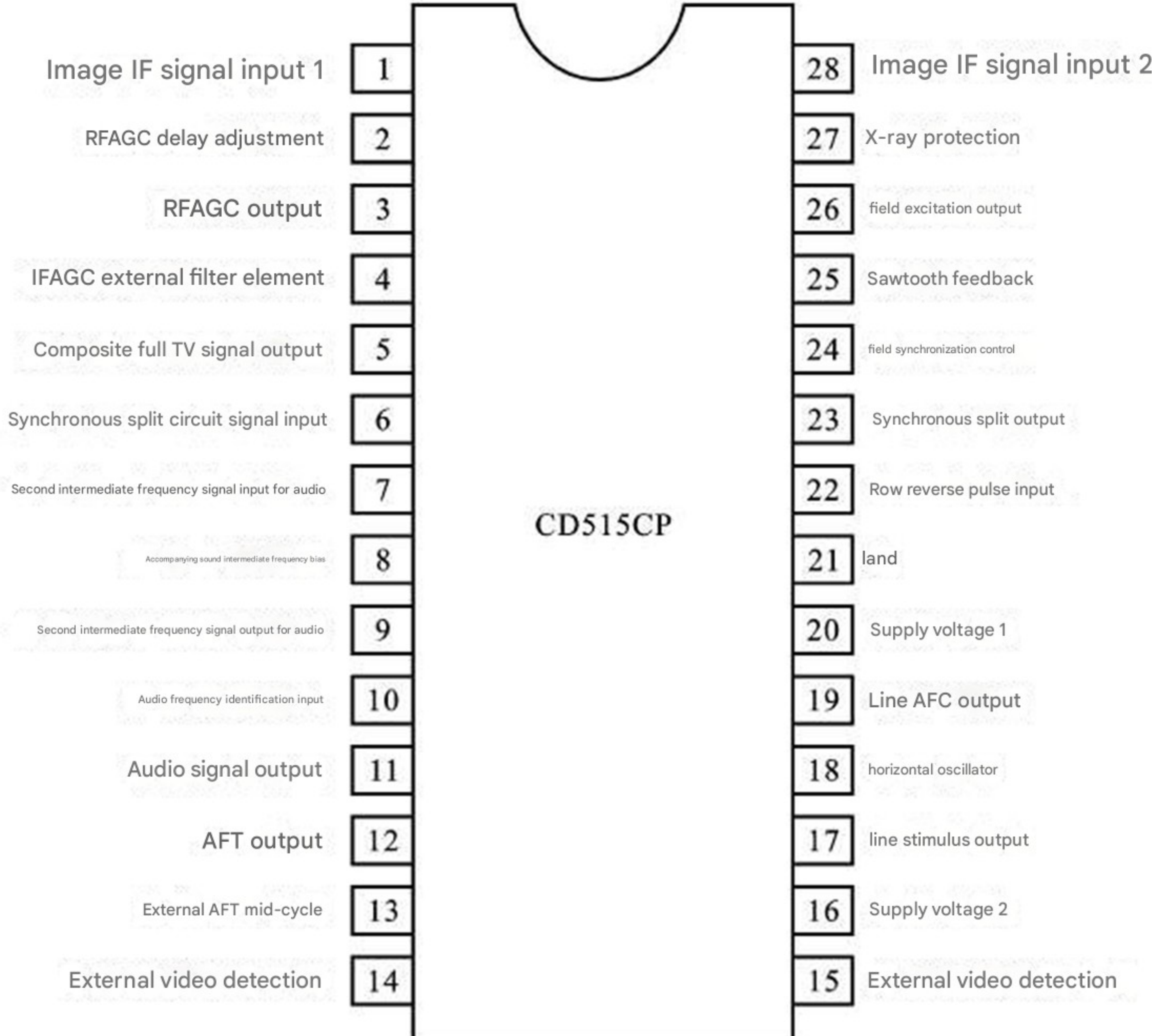


Figure 5-3 CD515CP pin function diagram

Table 5-1 DC voltage and ground resistance of each pin of integrated circuit CD5151 (when power is off)

serial number	Function	Remark	DC voltage/V		Resistance to ground/2
			No signal	There is signal	black pen ground
1	Image IF signal input 1		4.8	4.8	1.3 k
2	RFAGC delay adjustment		5.8	5.8	1.2 k
3	RFAGC output		2	3.1	1.2 k
4	IFAGC External filter element		5.8	5.2	1.2 k
5	Composite full TV signal output		4.5	3.2	1 k
6	Synchronous split circuit signal input		6	6.5	1.3 k
7	Second intermediate frequency signal input for audio		3	3	1.6 k
8	Accompanying sound intermediate frequency bias		3	3	1.4 k
9	Second intermediate frequency signal output for audio		4.5	4.5	1.4 k
10	Audio frequency identification input		4.5	4.5	1.3 k
11	audio signal input		3.2	2.4	1.3 k
12	AFT output	This machine is not in use	null	null	
13	External AFT mid-week	This machine is not in use	null	null	

5.4 ZX2035 schematic diagram and signal processing and transmission process analysis

The electrical schematic diagram of the ZX2035 black-and-white TV is shown in Figure 5-4 . The following describes the process of signal transmission, processing, and finally

restoration into images and accompanying sounds in the TV, based on this diagram.

The RF full TV signal (including the accompanying audio signal) is received by the antenna

After that, it directly reaches the pin 1 of the electrically tuned high-frequency head TDQ (see Figure 5-1) . After entering the high-frequency head from

[illegible] 9 [illegible] C4 [illegible]

pin 1 , it first passes through the input filter, and then undergoes high-frequency amplification, tuning, frequency conversion and other processing to become a 38MHz intermediate frequency full-frequency

the transistor Q1 is combined to reach the base of the transistor Q1, and Q1 is used as the amplifier to form the

The intermediate frequency amplifier circuit amplifies the intermediate frequency full television signal. The amplified signal is coupled from the collector of Q1 to the surface acoustic wave filter (S u r f a c e Aco us ti c W a

v e Fil ter , abbreviated as SAWF) SBM SF 381 1 is used for filtering. The surface acoustic wave filter is a new type of filter device. It has the special intermediate frequency response characteristics required by television sets. It only allows the 38 MHz image intermediate frequency signal and the

31.5 MHz first audio intermediate frequency signal to pass through in a certain required ratio , while other interference and noise are filtered out or absorbed.

enters the integrated circuit from pin 1 and pin 28 of CD5151 .

the integrated circuit CD5151 , the signal is processed by the intermediate frequency amplifier, video detection, video amplifier, noise reduction and other unit circuits, and then output from the 5th pin (see Figure 5-2). At this time, the signal output from the 5th pin is a composite full television

signal, which includes a 0-6MHz image signal , a 6.5MHz second audio intermediate frequency signal, and a composite synchronization and blanking signal. After this signal is output from the 5th pin , it is divided into three paths and processed separately .

（1） The first path passes through the AV/TV conversion switch K1 and

resistor R49 to

The base of the final video amplifier Q8 is reached, and Q8 is the main component of the final video amplifier.

The video signal is finally amplified by the frequency amplifier circuit. The amplified video image signal is output from the collector of Q8 , and reaches the cathode of the picture tube through the coupling capacitor C45 and the cathode current limiting protection resistor

R51 of the picture tube. Since the control grid of the picture tube is grounded, the higher the level of the image signal reaching the cathode of the picture tube, the darker the screen display is, so it is a negative polarity image signal.

（2） The second path is composed of R15，R16，C72，C16

After filtering network, it is sent back

to the integrated circuit through its 6th pin for

Line synchronization separation processing, separated line and field synchronization signals

The oscillation frequency and phase of the line and field oscillators are controlled respectively, so that the line and field scanning signals generated by the line and field oscillators

are kept at the same frequency and phase as the line and field scanning signals transmitted by the TV station. If they are not synchronized, the original image cannot be reproduced stably, and the image on the screen will roll or move. The internal circuit block diagram of CD5151 can be

seen in Figure 5-2 .

（3） The third path is to the right through 6.5MHz after passing through capacitor C17

Ceramic filter Y1 , through the filtering effect of Y1, only the second sound intermediate frequency signal of 6.5MHz returns to the 7th pin of CD5151CP , enters the integrated circuit, is amplified by the SIF

(abbreviation of sound intermediate frequency) inside the integrated circuit , outputs from the 9th pin, passes through T1 and returns to the integrated circuit from the 10th pin , then is detected by the frequency detector and output from the 11th pin, passes through R20, C85, K1 , R87 ,

2R P1 , C82 and other components , and enters the internal of the integrated circuit IC2 (D386P) from the 3rd pin to realize audio signal amplification.

The internal noise reduction circuit unit of CD5151 is shown in Figure 5-2 .

In addition to sending the above-mentioned full TV signal from pin 5 for processing, the circuit unit also sends the full TV signal to the two unit circuits of IF AGC (abbreviation of automatic gain control) and RF delay

AGC inside the integrated circuit . The output of IF AGC controls the gain of the image IF amplifier, while the output of RF delay AGC is output from pin 3 and sent to pin 2 of the high-frequency head through R 9 to control the gain of the high-frequency amplifier. The capacitors C 9 and C 8 connected to the

ground at both ends of R 9 are used for filtering, so that the potential sent to pin 2 of the TDQ high-frequency head for high-frequency AGC control is

Other components related to high-delay AGC include

The potentiometer R P1 connected to the second pin of CD5151 is used to adjust the delay of the high-frequency AGC . R 12 and R 13 are used to divide the power supply voltage, and C 13 is a filter capacitor. R 14 and C 14 connected to the fourth pin of CD5151 determine the time constant of the

AGC filter circuit. Both of these automatic gain control circuits are negative feedback circuits. When the signal received by the antenna is strong, the intermediate frequency automatic gain control circuit will work first. When the signal received by the antenna is further enhanced, the radio frequency will be Delay AGC also takes effect, and the

results of their action are

Make the gain of the controlled intermediate frequency amplifier and high frequency amplifier

The AGC circuits are closed when the signal received by the antenna is weak to a certain extent, and the gain of the intermediate frequency amplifier and the high frequency amplifier are both at the maximum

state.

5.5 Analysis of the power supply circuit of ZX2035

ZX2035 is separated from the overall electrical schematic diagram and shown separately in Figure 5-5 .

The 220V , 50Hz mains electricity is reduced to 12V50Hz by transformer T01 .

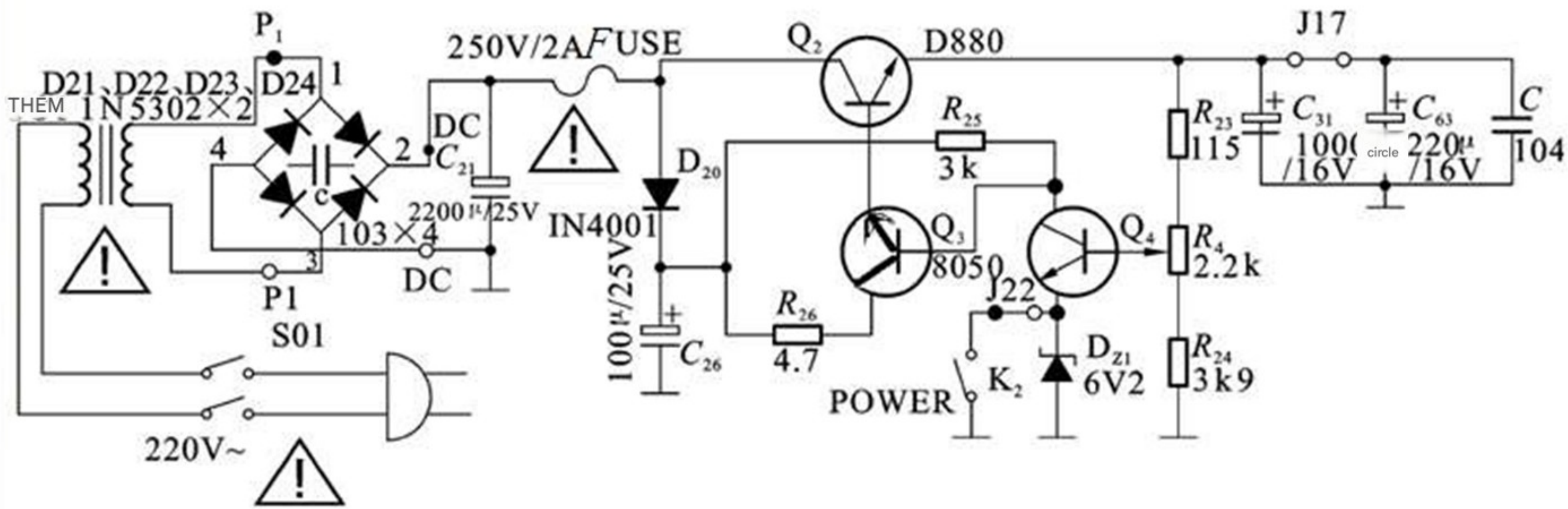


图 5-5 ZX2035 power supply circuit

After the low voltage is reached, it passes through the bridge rectifier composed of four diodes D21 ~ D24 .

The rectifier rectifies the pulsating DC voltage. C21 and C26 are filter capacitors for the input DC pulsating voltage. FUSE is a fuse that protects when the current exceeds 2A . R23 , R4 , and R24 form the sampling resistor .

chain, Q4 is a comparison amplifier tube, and its base input is the output voltage

The sampling value of the output is connected to the reference voltage

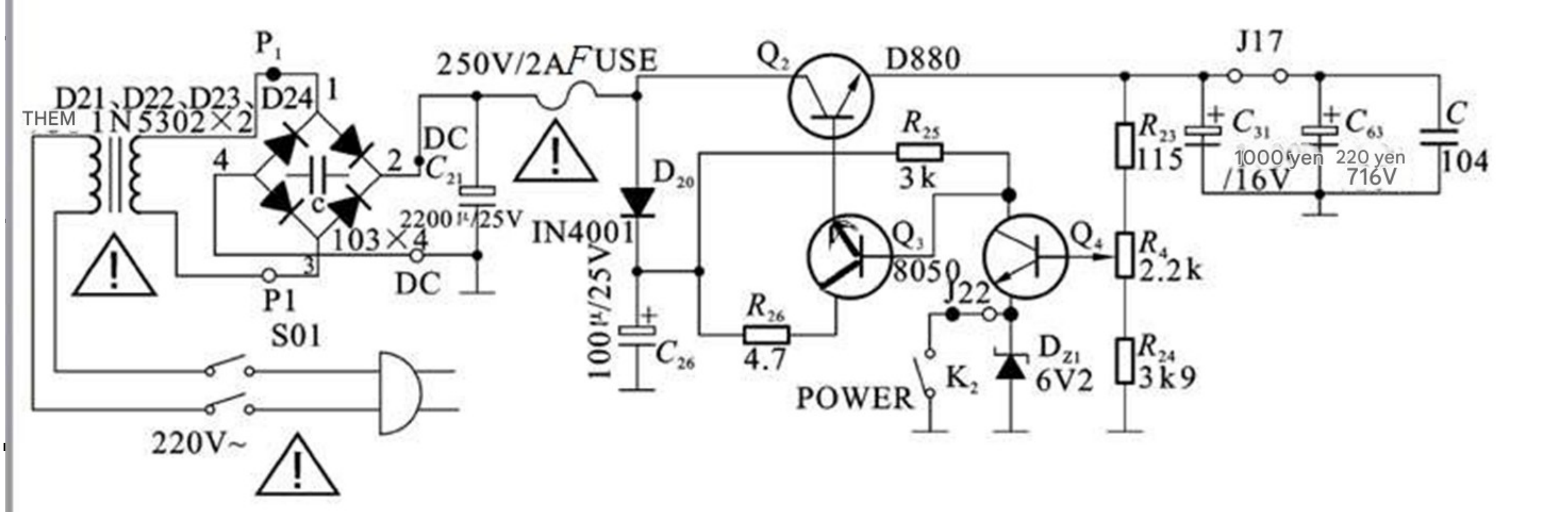


图 5-5 ZX2035 power supply circuit

TUBE Q2 .

□□ Q_2 □□□□□□□□□□□□□□□□□

The emitter output voltage of Q2 is stabilized near the set value. R_{25}

This stabilizes the emitter output voltage of Q2 near the set value.

R25 is the collector load resistor of Q4, R26 is the collector resistor of Q3 . Diode D20 plays the role of voltage reduction and isolation, C26 is the input filter capacitor of the voltage stabilizing circuit . C31 , C63 , and C are output filter capacitors.

By adjusting the position of the center head of R 4 , the sampling voltage is changed, so the

The output voltage of the voltage regulator circuit is adjusted in the range of about 9 to 12V . When the machine works normally, it should be adjusted to 10.8V . K2 is the power switch. When K2 is turned on, the emitter of Q4 is grounded, and Q4 will be

in **saturation conduction** .

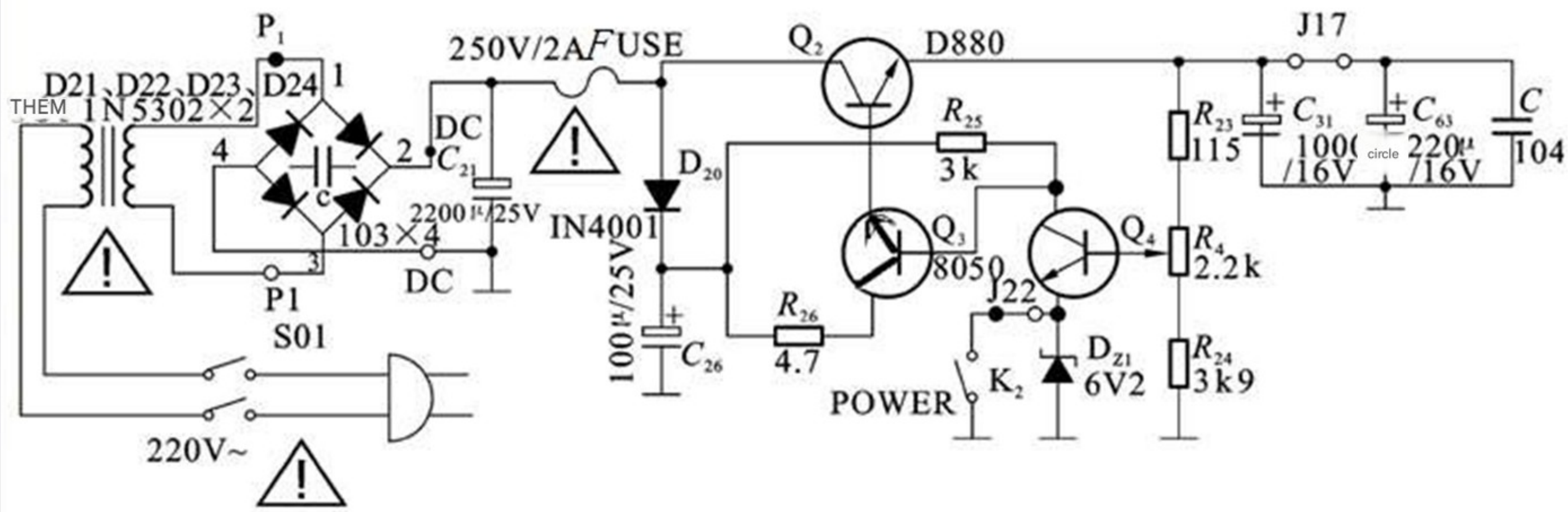


图 5-5 ZX2035 power supply circuit

The regulated power supply is in the on state and cannot drive Q3 and Q2 to work.

Output, the TV does not work. When K2 is disconnected, the power supply is in normal working state and the TV works. Since the on and off of the power switch K2 of this machine does not control the on and off of the input AC mains,

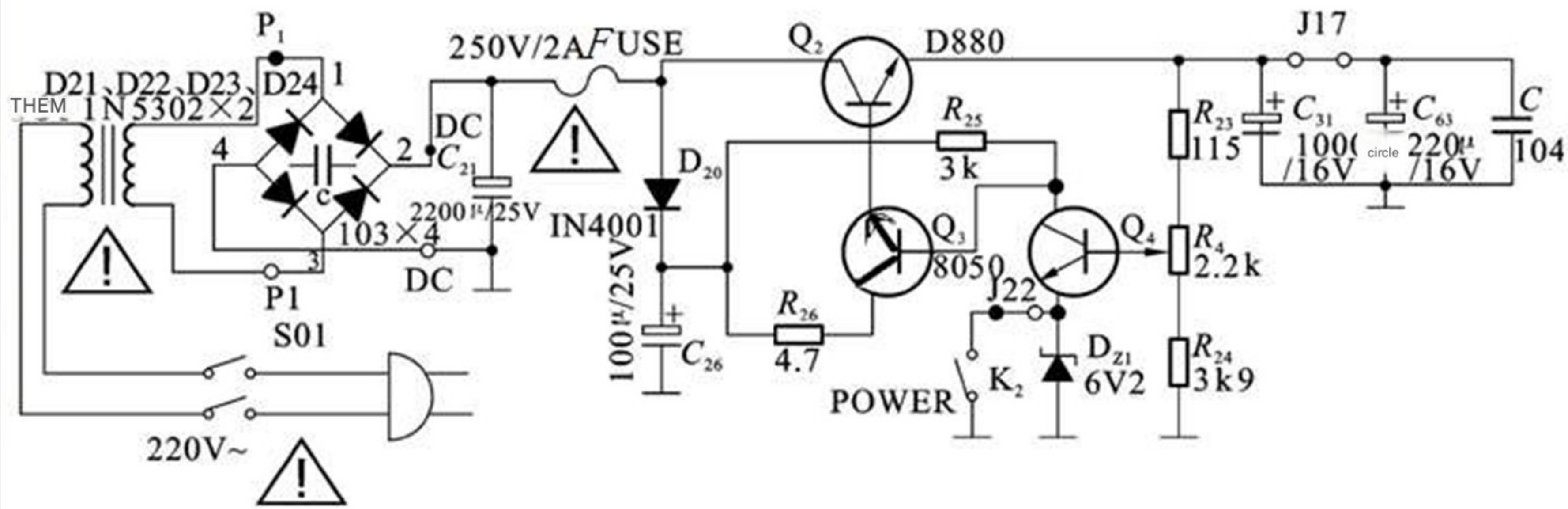


图 5-5 ZX2035 power supply circuit

After shutting down the machine, unplug the power plug, otherwise the power supply of the machine will

The transformer and rectifier filter circuit are still in working state, usually called standby state, which is a defect in the design of the power switch of this machine.

So how does K2 control the TV to work or not?

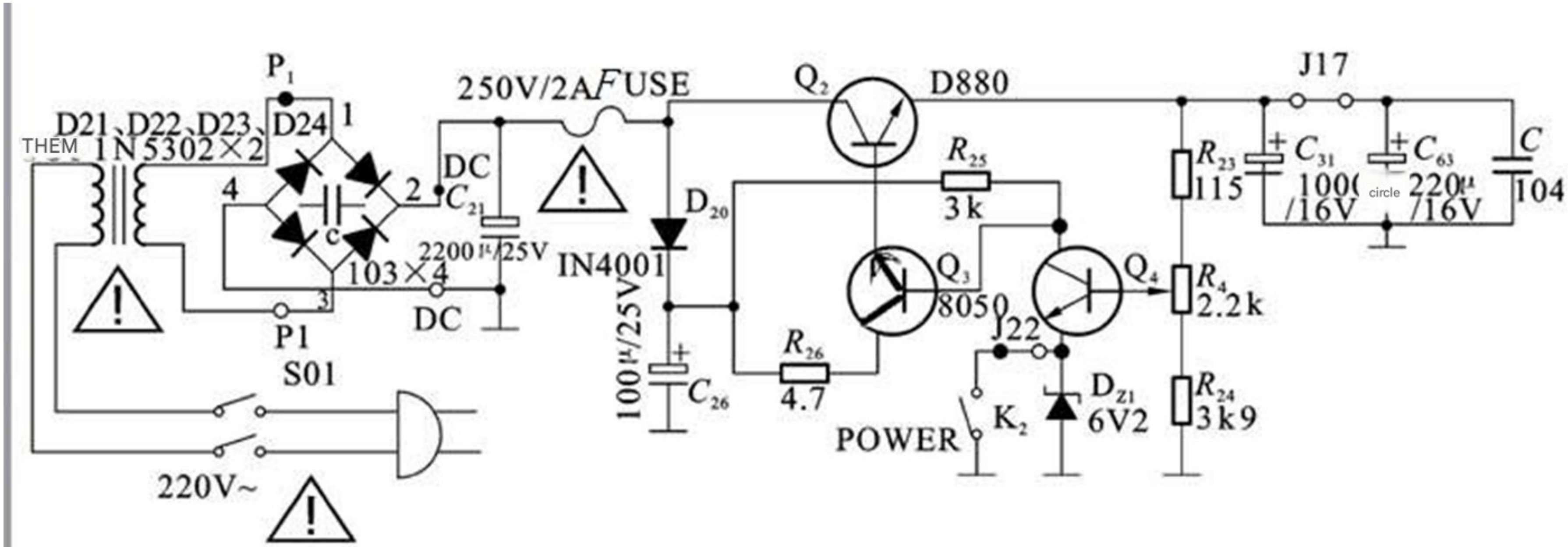


图 5-5 ZX2035 power supply circuit

It can be seen that when K2 is turned on, Z1 is short-circuited and the base voltage of Q4 is

High, making Q4 saturated and turned on. In this way, the base potential of Q3 is very low, and the two emitter junctions of Q3 and Q2 cannot be turned on. Therefore, Q2 is in the cut-off state, the voltage regulator circuit has no output, and

the TV cannot work.

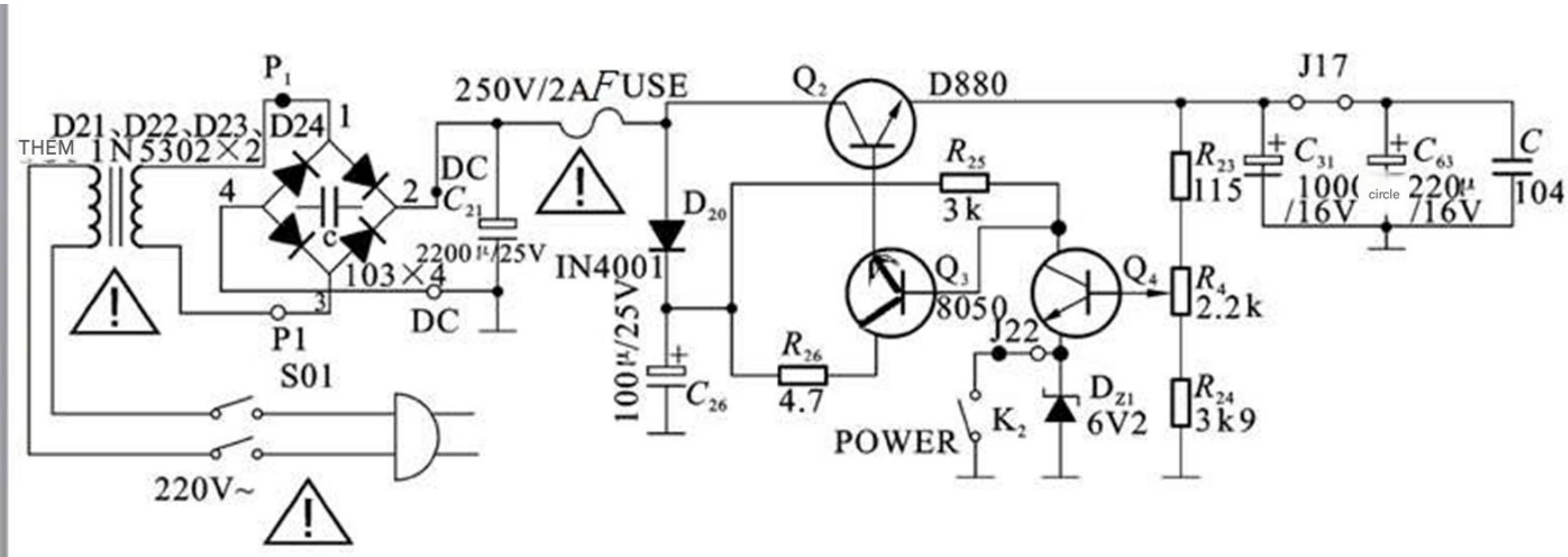


图 5-5 ZX2035 power supply circuit

K2 is disconnected, the voltage stabilization circuit returns to normal.

The principle is the same. Only when the normal and stable voltage is outputted can the TV work normally. Therefore, K2 is just a secondary switch, and the real power switch is the plug.

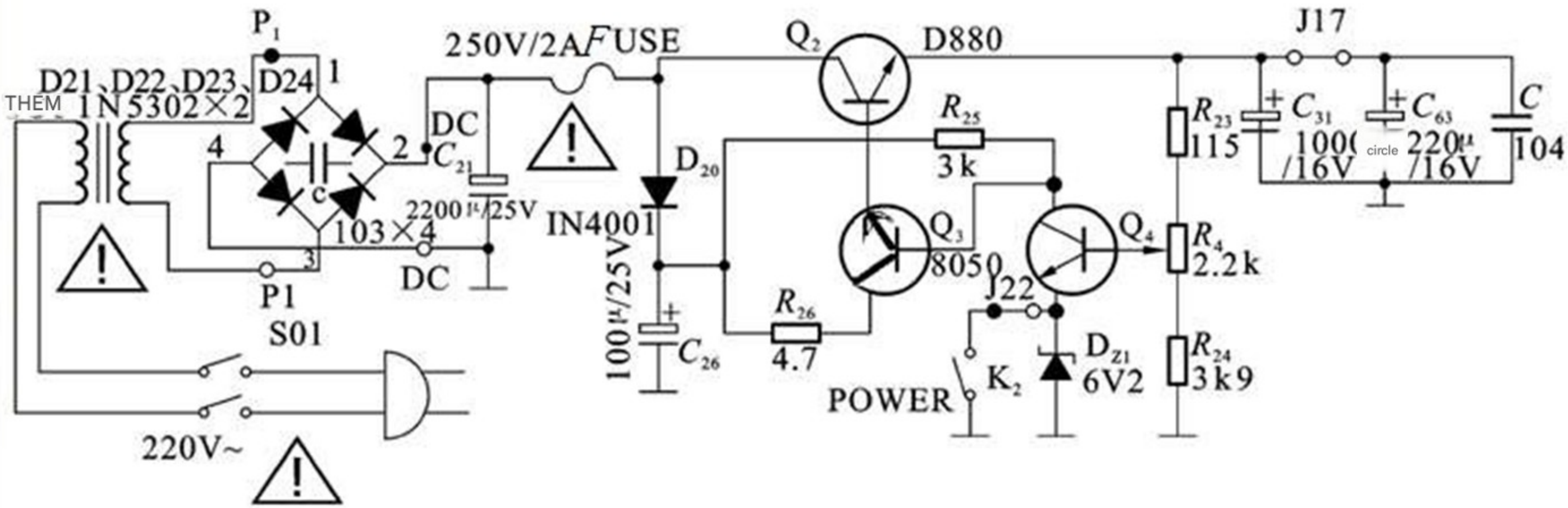


图 5-5 ZX2035 power supply circuit

[Note that in the electrical schematic diagram, a circuit simplified drawing method, which means that each diode in the rectifier bridge is connected in parallel with a small ceramic capacitor. Since large inductors and capacitors are often turned on and off in the power grid, large spike pulse interference often occurs in the power grid.

Pulse is the unilateral signal analyzed in the " Signal and System " course.

The frequency spectrum of the diode is very wide, and a surge current is formed in the rectifier circuit. After a small ceramic capacitor is connected in parallel to each diode, it can play a dual role of filtering and protecting the diode. Practice has proved that the probability of diode damage can be

reduced after connecting capacitors in parallel.

In the schematic diagram of the whole machine, at the nodes of D20 , R26 , and R25 ,

OR 2 is connected , and the other end of the resistor is connected to the 9th pin of the row output transformer. This indicates that the supply voltage

of the row output stage

It is related to the voltage of this line. In fact, the 10.8V output of the regulated power supply

The regulated voltage is also connected to the 9th pin of the row output transformer via the boost capacitor C54 . In this way, the supply voltage of the row output stage is actually the regulated voltage of 10.8V plus the voltage across C54 . The diode D9 is

called a boost diode, which plays an isolation role.

After basically understanding the working principle and components of the power supply circuit

After the effect, it is necessary to compare the electrical schematic with the printed circuit board diagram and **the actual printed**

circuit board to verify whether they are consistent. If any discrepancies are found, they should be carefully considered and

Make the correct judgment whether to modify it. If so, make a detailed

Detailed records.

Most of the printed circuit boards of TV sets are single-sided boards, and the printed circuit board of the ZX2035 TV set is a single-sided board. Since the circuit principle of the TV set is relatively complicated, it is

inevitable to use a small number of " jumpers " to make up for the shortcomings of the single-sided printed circuit board. According to the component list of ZX2035 , ZX2035 has a total of 16 jumpers. These jumpers need to be prepared by yourself. These jumpers should use

different colored wires according to their different positions in the electrical schematic. Generally speaking, the grounding is black.

Color, red for positive power supply, green for signal transmission,

use different colors such as yellow, blue, etc., and you can keep a record for debugging and maintenance. There are two jumpers in the power circuit, namely J17 and J22 . Their corresponding positions in the schematic diagram have been marked in Figure 5-5 .

A TV set uses a wide variety of

components in huge quantities. However, not all components are soldered on the printed circuit board, such as transformers, deflection coils, speakers, and picture tubes. The circuit connection between these devices and the components on the printed circuit board must rely on connectors.

The connectors used by ZX2035 are 2 -wire sockets P1 , P2 ,

A4 and 4- wire sockets P3 and P4 . P1 is used to connect the power transformer and the rectifier bridge. P2 is used for external antenna (2 wires are combined into 1 wire), A4 is used to connect the speaker and the printed circuit board, P4 is used to connect the deflection coil and the printed circuit

board, and P3 is used to connect the cathode ray tube socket and the printed circuit board .

jumpers and connectors on the ZX2035 circuit diagram.

Yes, they are just equivalent to disconnecting a connecting line on the circuit schematic , drawing two dots, and then connecting the two

dots with wires.

The reader should refer to the electrical schematic

The locations of these jumpers and connectors in the schematic diagram are marked on the printed circuit board to facilitate debugging and maintenance. The

locations of the connectors in the power circuit are marked in Figure 5-5 .

5.6 ZX2035 power supply circuit

This section will further analyze how the DC regulated power supply supplies power to each unit circuit of the machine. Through analysis, the ability to read drawings will be further improved, and preparations will be made for welding, assembly, debugging and maintenance of the

ZX2035 TV set.

The power supply circuit of the stabilized power supply to each unit circuit of this machine can be used first

The block diagram is shown in Figure 5-6 . The regulated power supply has two output lines, one is 10.8V and the other is the common ground line, which is 0V . The figure shows n

power unit circuits.

When the terminal is connected, there is usually a voltage drop resistor and three filter capacitors.

A π -shaped filter is formed.

Sometimes, R_n, C_{n3} or C_{n2} can be omitted, depending on the situation.

The electrolytic capacitor is used for low-frequency filtering, while the small-capacity ceramic capacitor is used for high-frequency filtering.

ZX2035 , which are introduced below.

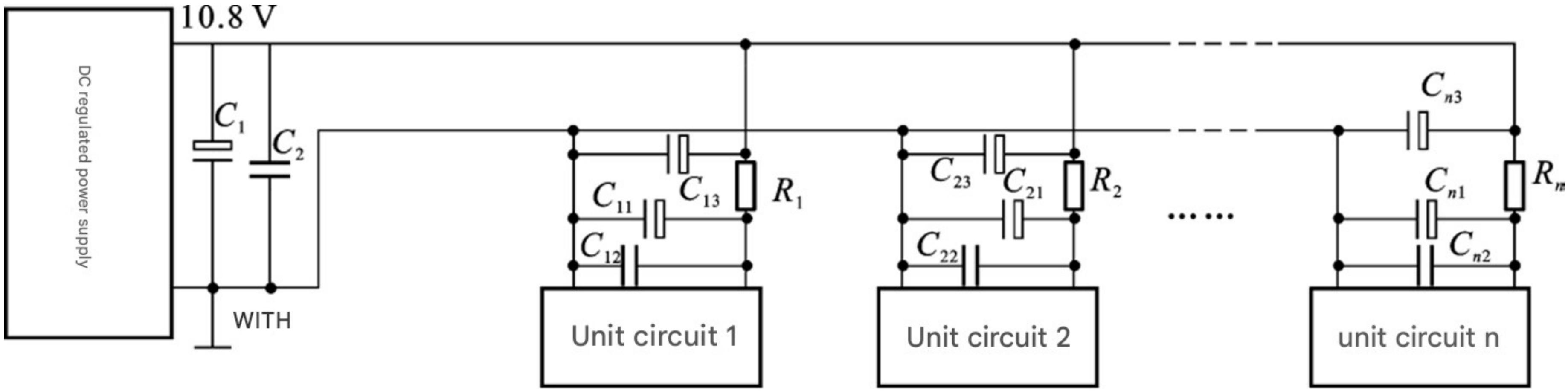


Figure 5-6 Power supply circuit block diagram

（1） The first power supply circuit is a rectified and filtered DC

The voltage directly supplies power to the row output tube Q10 . See the schematic diagram 5-4 of the whole machine. The power supply path is: starting from the cathode of the diode D20 , going down through the positive node of C26 to the right, and then going down along this line through the

resistor OR2 , reaching the 9th pin of the high-voltage package FBT , and from the 9th pin through the internal coil of the high-voltage package to the 10th pin of the high-voltage package. The 10th pin is connected to the 3rd pin, and is also the collector of the row output tube Q10 . This is the power supply circuit after rectification and filtering mentioned above.

（2） The second power supply circuit is a voltage regulator circuit that pushes the

the driving tube Q9 . Looking at the schematic diagram of the whole machine, the power supply path is: starting from the emitter of Q2 , reaching the rightmost node, passing through the resistor R53 , that is, reaching the collector of Q9. R53 is the collector load

of Q9 .

（3） The third power supply circuit is the voltage stabilizing circuit that supplies power to Q10 .

The power supply path is: Starting from the emitter of the adjustment tube Q2, going rightward to the right, reaching the right-angle turning point, upward to the second node, and going

rightward through D9 to the 10th pin of the high- voltage package FBT .

to Q10 , but this power supply is only available when D 9 is forward conducting.

In fact, the voltage supplied to the row output tube Q10 is the result of the series connection of the 10.8V stable voltage and the voltage across the boost capacitor C54. Therefore, the supply voltage must be greater than 10.8V , about 14V . C54 is called the

boost capacitor, and D9 is the boost diode.

（4） The fourth power supply circuit is to the high-frequency head and frequency band selection

The switch is powered. Also starting from the emitter of Q2, it passes through R11 and reaches the 8th pin of the electrically tuned high-frequency

head TDQ . This is the same as the frequency band selection.

of the selector switch K3 is the equipotential point (K3 is a linear pole triple-throw switch) can also be regarded as the same node. The filter circuit composed of R11, C5 and C6 reduces the DC stable voltage reaching the TDQ8 pin to 9.1V . In addition to supplying power to the high-frequency head, this voltage is also used for frequency band selection through K3.

When the DC voltage is added to the 6th , 5th and 3rd pins of TDQ through K3 , the VL , VH and U frequency bands are selected respectively .

（5） The fifth power supply circuit is to supply power to the intermediate amplifier Q1 .

The power supply path is: starting from the lower node of R11 , passing through R1 to the right , that is, reaching the bias circuit and collector load of Q1 to supply

power to Q1 . The right end of R1 is connected to two filter capacitors C11 and C69 at the same time . C35 on the left side of R1 is a 0.01μ ceramic high-frequency filter capacitor, which is shared by these two power supply branches. The positions of these

two branches on the printed

circuit board are

Place it close to the output terminal of the regulated power supply but far away from it.

At the output end of the DC regulated power supply, in addition to using a large capacitor

In addition to the electrolytic capacitor filtering, a

0.01μF or 0.1μF small ceramic

capacitor. This is because the

large - capacity electrolytic capacitor is large in size, and the parasitic inductance generated by the manufacturing process is also large, and it is easily affected by the external magnetic field. It is only suitable for low-frequency

filtering. If you want to filter out high-frequency interference and noise, you must connect it in parallel.

A small-capacity ceramic capacitor with low parasitic inductance.

When the regulated current power supply supplies power to a distant power unit circuit through the printed circuit, a large-capacity electrolytic capacitor and a small-capacity ceramic capacitor should be connected in parallel at the

entrance of the power unit circuit for filtering. The size of the electrolytic capacitor at the entrance depends on the current size of the power unit and the requirements for ripple .

（6） The sixth power supply circuit is to large-scale integrated

The power supply path is: from the emitter of Q2 to the right, to the node of C63 , and then to the 20th pin of CD5151 after further voltage reduction and

filtering by R41 and C43 , to power the internal unit circuit of the large-scale integrated circuit CD5151 . When the TV is working normally, the power supply voltage is 10.8V , and the 20th pin of CD5151

The voltage of the pin is 9.6V , that is, the voltage drop across R41 is

10.8V − 9.6V =1.2V , then

the current supplied to

CD5151 through R41 is I =

1.2V/8.2Ω =

0.14A , or 140mA . Usually you

can use a test resistor The magnitude of the voltage across the two ends is divided by the resistance value to estimate the magnitude of the branch current.

（7） The seventh power supply circuit is also to CD5151 . From the schematic diagram, starting from the emitter of Q2 to the right, to the rightmost turning point upward, to the left at the first node, through R47 to the 16th

pin of CD5151 , which is the second DC voltage input terminal of CD5151, and C44 is the filter capacitor of this input terminal .

（8） The eighth power supply circuit is to supply power to the audio power amplifier

The path is: still starting from the emitter of Q2 , going right to the inflection point, upward to the second node, left to the second inflection point, then upward, to the third inflection point and

right, passing through R83 to reach the 6th pin of the audio power amplifier integrated circuit IC2-D386P , supplying power to the unit circuit. C86 is the filter of the DC voltage input at the chip end

There is no small capacitor in parallel with the power input of this

chip.

【Note】: Why is the DC supply in some unit circuits

At the entrance of the DC voltage, only a large electrolytic capacitor is connected in parallel for low-frequency filtering, but no small ceramic capacitor is connected in parallel for high-frequency filtering? This fully shows that electronic

technology is an experimental science, which is mainly determined by experiments. The theory only points out the direction of progress. At the entrance of the DC voltage of some unit circuits, there is no high-frequency interference or the parasitic capacitance of the circuit

itself completes the function of high-frequency filtering. The actual circuit distribution may be very complicated and should be determined based on experiments.

（9） The ninth power supply circuit is to the field output stage and field excitation

The power supply path is: starting from the emitter of Q2, through R34 , it reaches the collector of the field output tube Q6 , thereby supplying power to Q6 . Since Q7 is a complementary transistor connected in series with Q6 , it is also powered by the emitter of Q6.

At the right end of R34 , through R33 , R32 , R31 , and D7 , it not only achieves the purpose of supplying power to Q5 , but also forms a micro-conduction bias circuit when the base of Q6 and Q7 is static. The electrolytic capacitor C23 on the left side of R34 is a filter capacitor.

（10） The tenth power supply circuit provides power to the second pin of CD5151.

Provides an adjustable DC voltage to achieve the RFAGC delay amount

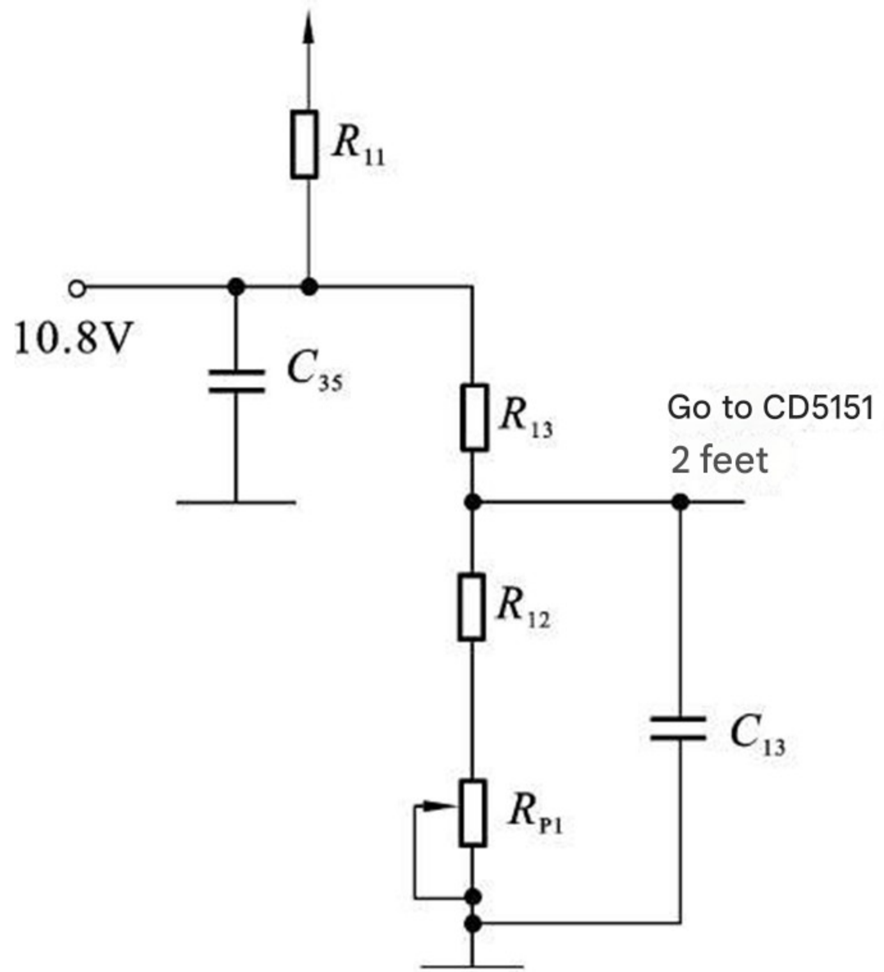


Figure 5-7 Article 10 Equivalent drawing of power supply circuit

It is achieved by the following power supply path: Starting from the node at the lower end of R11 , it reaches the

second foot of CD5151 through R13 . The circuit is related to R12 , W1 and C13 . R12 , W1 and R13 are connected in series.

Press and adjust the position of the center head of W1 to change the second pin of CD5151 is changed , and C13 plays a stabilizing or filtering role. This power supply circuit can be redrawn as shown in

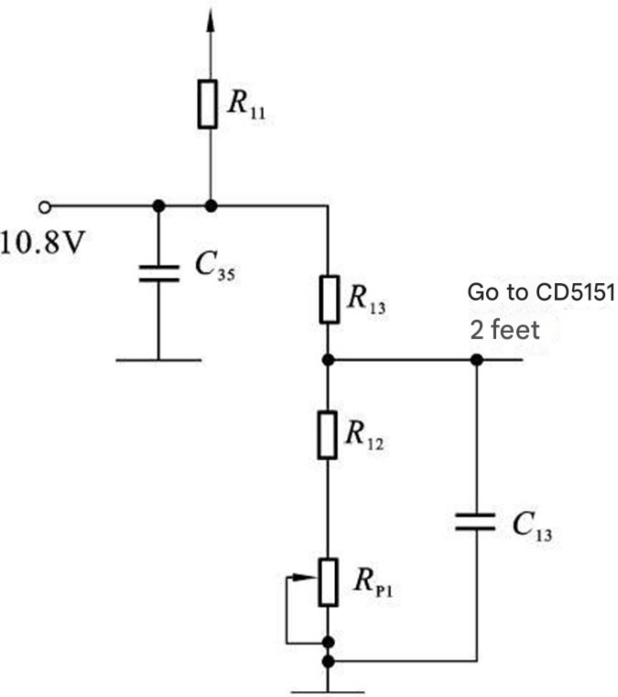


Figure 5-7 Article 10 Equivalent drawing of power supply circuit

Figure 5-7 , which is clearer. In addition, there are some auxiliary circuits in the unit circuits that introduce their own power supply from the above ten power supply circuits, which

will be introduced in the unit circuit analysis later

.

5.7 Analysis of the high frequency tuner and its associated circuits of ZX2035

ZX2035 uses UVD6201-RB full-channel electronic tuner (abbreviated as TDQ), which has 10 pins, as shown in Figure 5-4 . Pin 1 is connected to the antenna, which is the input terminal of the RF full-channel TV signal; Pin 2 is the RFAGC input

terminal; Pins 3 , 5 , and 6 are the band selection control terminals; Pin 4 is the tuning voltage input terminal; Pin 7 is unused; Pin 8 is the power supply terminal of the high-frequency tuner; Pin 9 is the 38MHZ intermediate frequency full-channel TV signal output terminal; Pin 10 is unused and the shell is grounded. Now we will introduce the auxiliary

circuits outside the above pins. Pin 1 is directly connected to the power supply terminal of the high-frequency tuner; Pin 9 is the 38MHZ intermediate frequency full-channel TV signal output terminal; Pin 10 is unused and the shell is grounded.

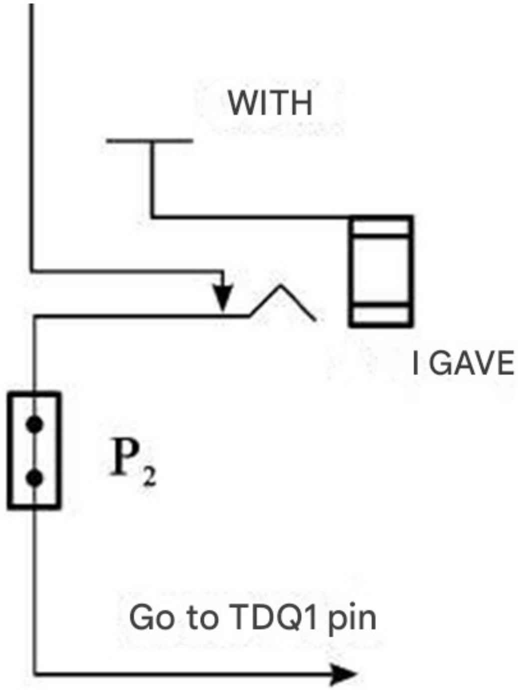
and the antenna. However, there is also a

ANTIN socket, when receiving radio signals, the antenna is connected to the moving piece of the ANTIN socket. When receiving cable TV signals, plug the cable into the ANTIN socket, the moving contact piece is disconnected from the antenna, and the cable TV signal is directly connected to pin 1 of

the high-frequency head .

[Note]: There is also a two-wire socket on the printed circuit board

The pin 2 of TDQ is the input terminal of the delayed RFAGC , which is produced by CD5151 .



picture **5-8** Antenna front-end assembly

Electrical schematic diagram

The generated RF delay automatic gain control voltage is output from its 3rd pin, divided by R9 and R10 , filtered by C9, C8 and C20, and added to the 2nd pin of TDQ . The 10.8V stable voltage output by the DC regulated power supply of the machine is

added to the 3rd , 5th ,
6th and 8th pins of TDQ .

The voltage of 9.1V is filtered again by the step-down and chip-side filter capacitors C35 , C5 , and C6 . The voltage of pins 3 , 5 , and 6 is added through the frequency band selection switch K3 , while the voltage of pin 8 is added directly because pin 8 is

It is the DC voltage supply terminal of the high-frequency head. K3 is a parallel moving

The single-pole three-throw switch has the input voltage connected to the knife end. The throwing ends are connected to pins 3 , 5 , and 6 respectively , corresponding to the selection of U , VH , and VL frequency bands respectively.

4 of TDQ is the tuning voltage input terminal.

needs to vary between 0 and 30V , so the line frequency AC voltage output from the 7th foot of the line output transformer (commonly known as the high-voltage package) of the line output stage is obtained after half -wave rectification by D14 and filtering by C56 .

+120V DC voltage, then step down through R8 , voltage regulator diode

D_{Z2} stabilizes to 33V , then is filtered by C_7 and sent to the potential through R_{27}

the device $2R_{P2}$, the center head of $2R_{P2}$ is connected to the 4th pin of the high-frequency head, and the lower end of $2R_{P2}$ is grounded. By adjusting the position of the center head of $2R_{P2}$, the potential of the 4th pin of the high-frequency head can be changed

between 0 and 30V , thereby realizing the selection of different channels.

9 of TDQ is the signal output terminal. The external R2 can effectively prevent noise and

Although the interference current has a shunt effect, it also has a shunt effect on the signal current.

5.8 Final video amplifier circuit of ZX2035

Since the load of the final video amplifier circuit (abbreviated as video amplifier) is the cathode of the picture tube, in order to make the picture tube fully modulated, a higher modulation voltage is required, about 50 to 80 volts peak- to -peak, so the power supply voltage of the final video

amplifier should also be higher. NPN transistor Q8 serves as the final video amplifier. R50 is its collector resistor, and the other end of R50 is connected to the cathode of D14 , which means that the line frequency AC output by the line output transformer through its 7th foot is rectified by D14 and filtered by C56 to obtain a +120V DC voltage , which is the power supply of the final

video amplifier. R54 ,

C 46 is the emitter bias resistor and bypass capacitor of Q 8 , so,

The basic circuit of the final video amplifier is shown in Figure 5-9 . The base of Q8 is static

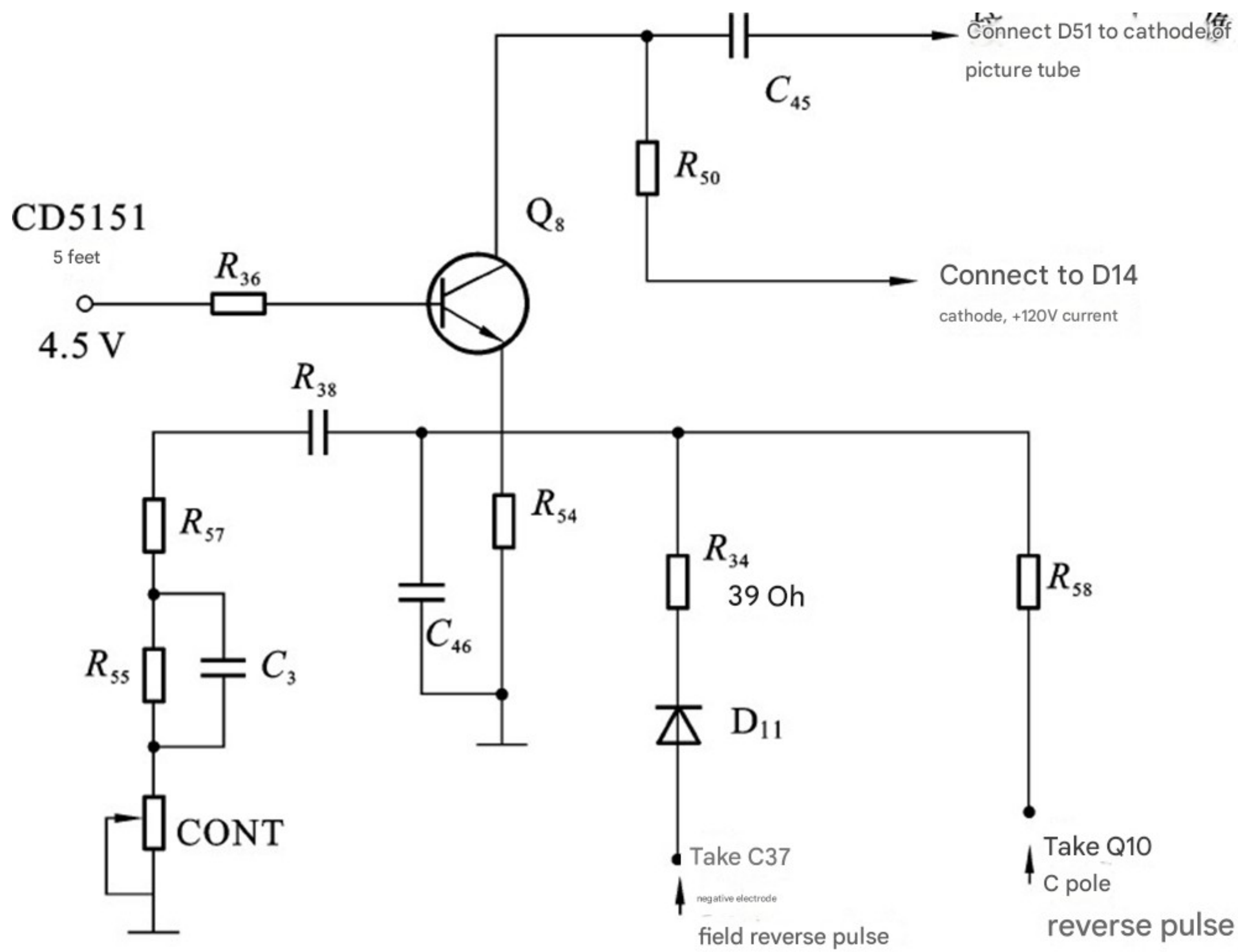


Figure 5-9 Final stage video amplifier circuit

The working point is CD5151 internal The circuit is provided by the external circuit.

When

static, the

5th pin of

CD5151

The potential is 4.5V ,

By circuit parameters

of Q8 can be obtained . The value of collector resistance R50

It is very critical and has a great impact on the gain and bandwidth of the amplifier . The larger the resistance, the greater the gain and the narrower the passband.

The ratio of the maximum brightness B_{max} and the minimum brightness B_{min} of a television image

The value is called the contrast of the TV image and is expressed as K.

$$K = \frac{B_{max}}{B_{min}}$$

Generally speaking , $K \leq 100$

The contrast ratio K depends not only on the TV

The intensity of the screen light also

depends on the brightness of the

environment when watching TV. Usually, people always watch TV in a darker environment.

This can reduce the minimum brightness to improve contrast, however,

, it is good if Bmin can reach 2 to 4 nits ,

while the maximum brightness of the picture tube

Bmax can generally only reach 100 to

200 nits. Therefore, it is considered

relatively good if the contrast of the

TV image can reach 30 to 40. TV sets

are equipped with contrast adjustment potentiometers. In TV circuits, the usual method of adjusting the contrast is to add a negative feedback circuit to the final video amplifier, and adjust the gain of the final video amplifier by adjusting the size of the negative feedback, thereby achieving contrast

adjustment. C38 connected to the emitter of Q8 → R57 → (R55 is connected in parallel with C3) →

CONT potentiometer → common ground branch (see Figure 5-9) is

It is set for contrast adjustment. CONT is the contrast adjustment potentiometer. C38 is a DC blocking capacitor, which is used to prevent the DC operating point of the video amplifier from being affected when the resistance value of CONT changes. There is only AC negative feedback in

this branch, but no DC negative feedback . C3 is a high-frequency compensation capacitor. The design and calculation of these parameters are left to the readers to complete.

When the contrast is small, the blanking pulse in the full TV signal does not

It is enough to completely cut off the electrons in the cathode ray tube, so that

To prevent this harmful phenomenon, The emitter of the stage video amplifier Q8 is also equipped with a horizontal and vertical blanking circuit, which uses the horizontal and vertical scanning reverse pulse to eliminate the retrace line on the grating. The horizontal reverse pulse is added to the emitter of Q8 through R58 from the 3rd pin of the horizontal

output transformer , and the vertical reverse pulse is added to the emitter of Q8 through Δ11 and R34 (39Ω) . When the horizontal and vertical reverse pulses arrive, the emitter potential of Q8 rises , Q8 is cut off, and the collector of Q8 is

* There are two R34 in the ZX2035 electrical schematic , one is 1Ω ,

One is 39Ω , please note the difference.

A high potential appears, the cathode potential of the picture tube increases, and the electron beam is cut off.

Retrace lines are eliminated. After adding this line and field blanking circuit, even if there is no TV signal input, the line and field reverse pulses generated by the TV's self-excited oscillation still exist, so there

will be no retrace lines on the scanning raster.

The last component to be mentioned is resistor R51, which is a the output coupling capacitor C45 and the cathode K of the picture tube limits the amplitude of the short-circuit current when a spark occurs inside the picture tube, thus playing a protective role.

5.9 Analysis of Line Scanning Circuit and Picture Tube Power Supply Circuit

1. The role of each component in the line scanning circuit

From the principle block diagram of the ZX2035 black-and-white TV shown in Figure 5-1 , it can be seen that the generation and processing of the oscillation signal of the line

scanning circuit are completed inside the integrated circuit, while the line drive stage and output stage are realized by discrete components. The power supply circuit of the picture tube is obtained by rectifying and filtering the line frequency AC output by the line output transformer.

The following is a combination of the ZX2035 electrical schematic and the

internal structure of the CD5151.

block diagram is used to analyze the working condition of the row scanning circuit.

TV signal output from the 5th pin of the →R 16 , and then enters the synchronization separation circuit unit inside CD5151 from the 6th pin . The separated horizontal synchronization signal is added to the horizontal automatic frequency control unit and compared with the horizontal reverse pulse input from the 22nd pin. The

comparison error voltage is output from the 19th pin and filtered by C 39. It is sent to the 18th pin through R 45 to control the horizontal oscillator inside the IC . The external components R 46 , R P7 , C 68 , and R 44 of the 18th pin are timing components, among which C 68 is the timing capacitor and R P7 is the

horizontal frequency adjustment potentiometer. The horizontal reverse pulse input from the 22nd pin is from the 5th pin of the horizontal output transformer through and

connected R 55 and C 45 are then filtered by C 60 and coupled to pin 22 through C 15.

Inside CD5151 , the horizontal frequency pulse square wave generated by the horizontal oscillator is directly added to the horizontal excitation unit for amplification, and then output from the 17th pin , filtered by C01 , and

added to the base of the transistor Q9 through R52. Since the horizontal frequency pulse square wave signal is added to the base of Q9, Q9 works in a switching state. When the high level of the pulse square wave arrives, Q9 is saturated and turned on, and when the low level arrives, it is cut off. R53 is the

collector load resistor of Q9, and the other end of R53 is connected to a 10.8V regulated power supply. The output of the collector of Q9 is coupled to the base of the horizontal output tube Q10 through C12 .

Q10 and the line deflection coil, line output transformer and other components form the line output

In the base circuit of Q10, D6 and R86 are used to absorb the reverse potential voltage and suppress high-frequency self - excitation; C34 is the S correction capacitor, D10 is the damping diode, and the capacitors 222J

and 223J connected in parallel with D10 are reverse capacitors. By adjusting their sizes , the size of the line amplitude can be adjusted. H-DY connected in series with C34 and then grounded is the line deflection coil, and FBT is the line output transformer. C54 and D9 are both connected

between the higher voltage after rectification and filtering of the local power supply and the DC voltage after voltage regulation. Their common function is to make the collector working voltage applied to Q10 higher than the regulated voltage .

The output voltage of the circuit. Therefore, they are called boost capacitor and boost capacitor.

The model of the horizontal output transformer is BSH8-6B , **which has 10 pins. The usage of each pin is as follows: Pin 1 is connected to the damping diode D10 ; Pin 2 outputs 6.3V voltage, which is connected to the 3rd**

pin of the picture tube through R66 and the 4 - wire socket P3 to supply power to the filament of the picture tube; Pin 3 is connected to the collector of the horizontal output tube D10 ; Pin 4 is grounded; Pin 5 is connected to Pin 22 of CD5151 through components such as C45 to provide reverse pulses for

horizontal scanning; Pin 6 is connected to Pin 8, and Pin 7 is connected to D14 to generate half - wave rectified medium voltage, which is filtered by C56 to form a 120V medium voltage to supply the accelerating electrode of the picture tube , etc.

Use, 8 -pin connected to high voltage rectifier diode to generate anode high voltage connected to display

Like the high voltage cap of the tube.

2. Working process of the row output stage

The working process of the horizontal output stage is analyzed as follows, taking a horizontal cycle as

an example. The square wave pulse applied to the base of the horizontal output tube Q10 is transmitted from the C pole of Q9 through the coupling capacitor C12 , as shown by u $_b$ in Figure 5-10 . During the time $_0$ to t1 , u b is high level, Q10

The C34 discharges to the horizontal deflection coil through Q10 , forming a positive

The deflection current i y is shown in Figure 5-10(b) . In the schematic diagram 5-4, i

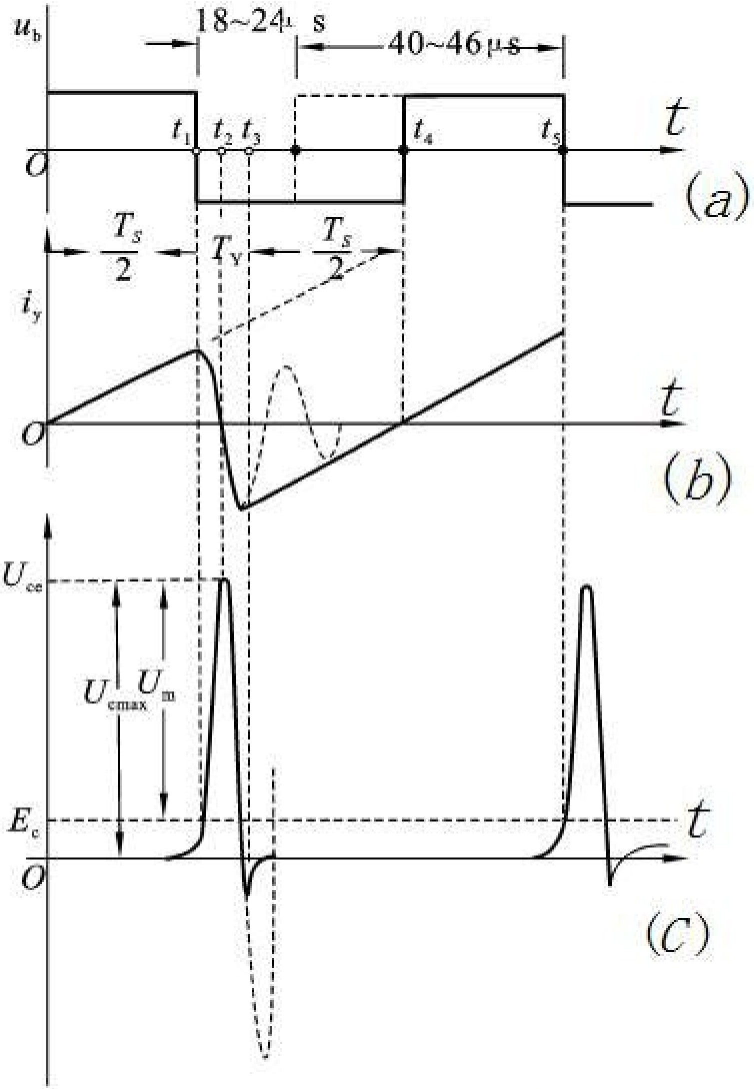


图 5-10 行输出级的有关波形

The positive direction is from bottom to top. At t1, u b drops , Q10 is immediately cut off, causing the horizontal deflection coil to generate a

very high reverse voltage as shown in Figure 5-10 (c) . This reverse voltage, together with the power supply voltage charged on C34 , is transmitted to the reverse capacitors 222J and 223J

through the coil between the 3rd and 1st pins of the horizontal reverse transformer FBT .

Charging, until the moment t2 , the magnetic energy stored in the horizontal deflection coil is exhausted,

When the charging current reaches zero, from time t2 , the reverse capacitors 222J and 223J discharge to the horizontal deflection coil through the 1st and 3rd pins of FBT and capacitor C34 until time t3 .

The discharge is about to end, and the

horizontal deflection coil turns back to 222J and 223J.

damping diode D10 connected in parallel with the reverse capacitors 222J and 223J conduct. As a result of the conduction of D10 , the electromagnetic energy exchange process between the horizontal deflection coil and the reverse

capacitor ends. As a result of the conduction of D10 , the magnetic energy stored in the horizontal deflection coil is evenly distributed.

The current is released linearly to form the lower half of the deflection coil current.

When the magnetic energy is released and the current is zero, it is exactly time t4 . At this time , u_b jumps from negative to positive, Q10 turns from off to on, and a new horizontal cycle begins. In the above process, the power supply voltage always charges C34

and 222J , 223J , and their charging and discharging are carried out on this basis. In the horizontal reverse process, that is, when Q10 and D10 are both off, the reverse bias high voltage generated by the horizontal deflection coil passes through the high-voltage package

The primary circuits 1 and 3 of the FBT partially transfer energy to the

secondary circuit.

Form high voltage, medium voltage, filament voltage and other power supply voltages.

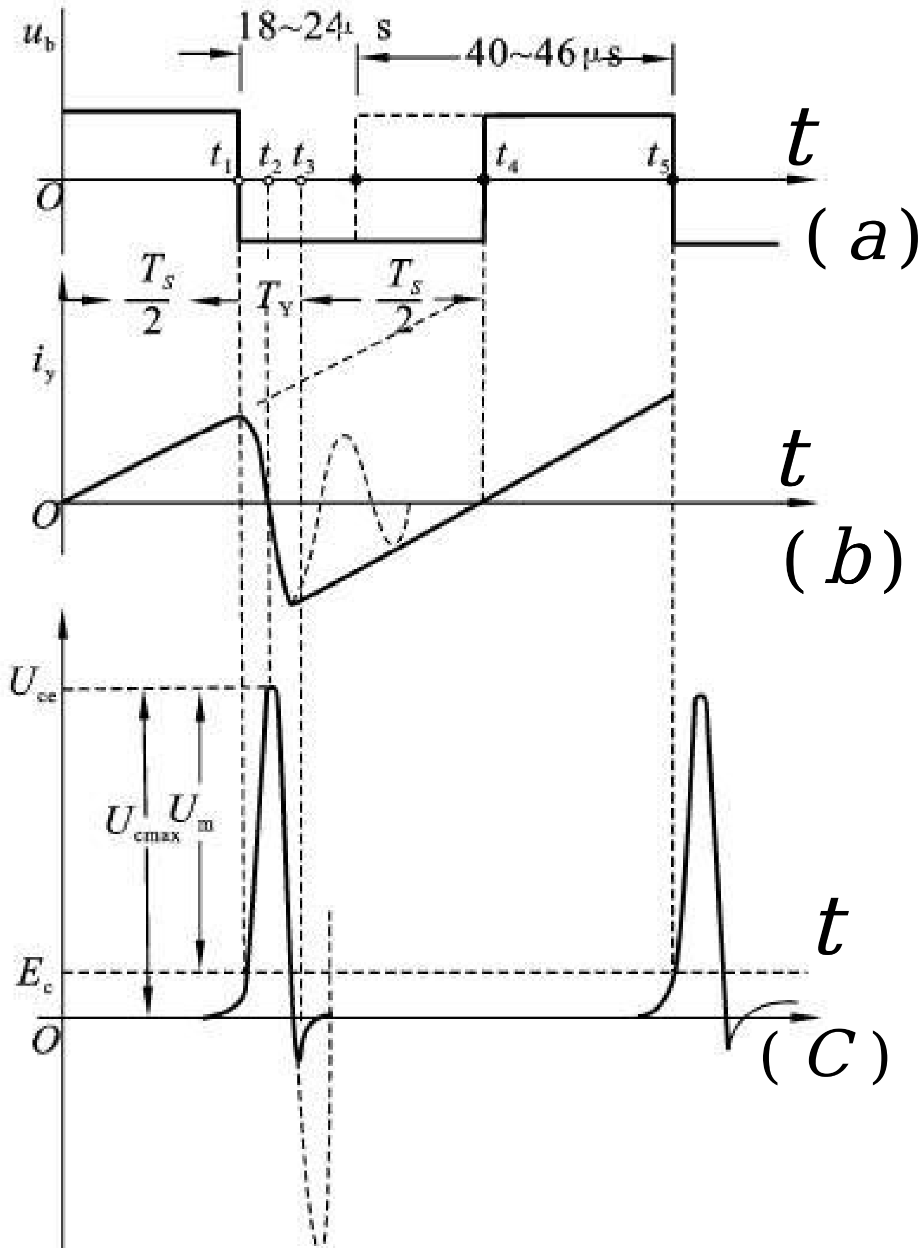


图 5-10 行输出级的有关波形

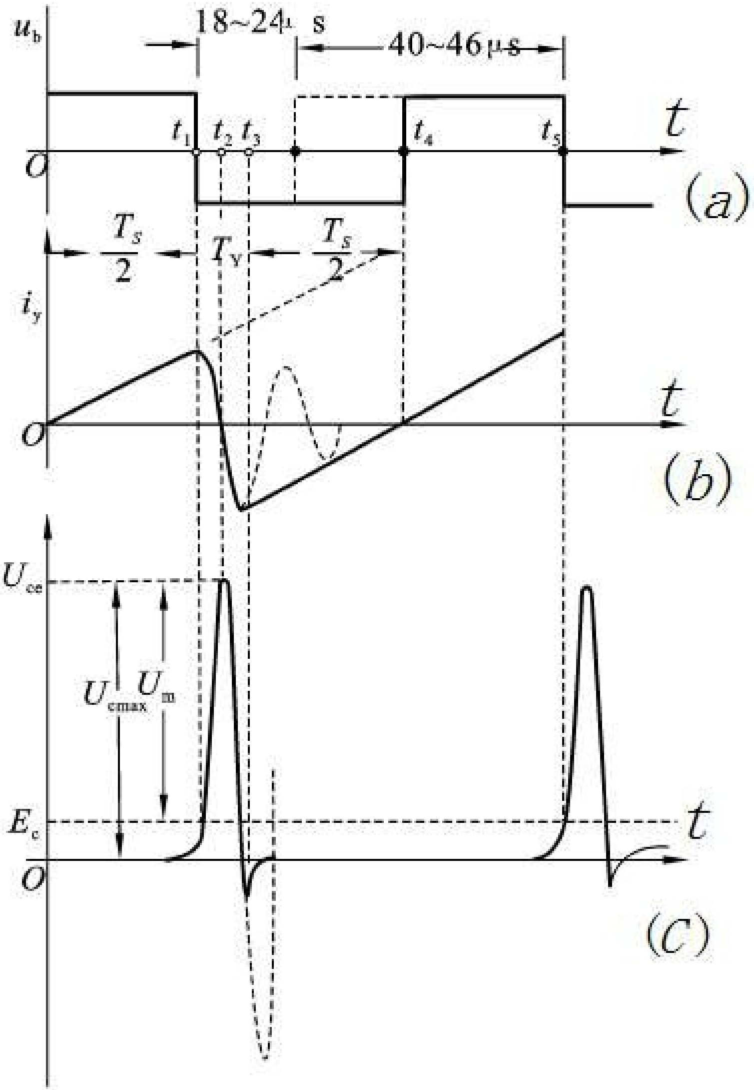


图 5-10 行输出级的有关波形

3. The structure and pin function of the cathode ray tube

The structural diagram of the cathode ray tube is shown in Figure 5-11 .

The cathode ray tube is an electric vacuum device. The tube is evacuated and the tube shell is made of high-strength glass, which can withstand high pressure to prevent

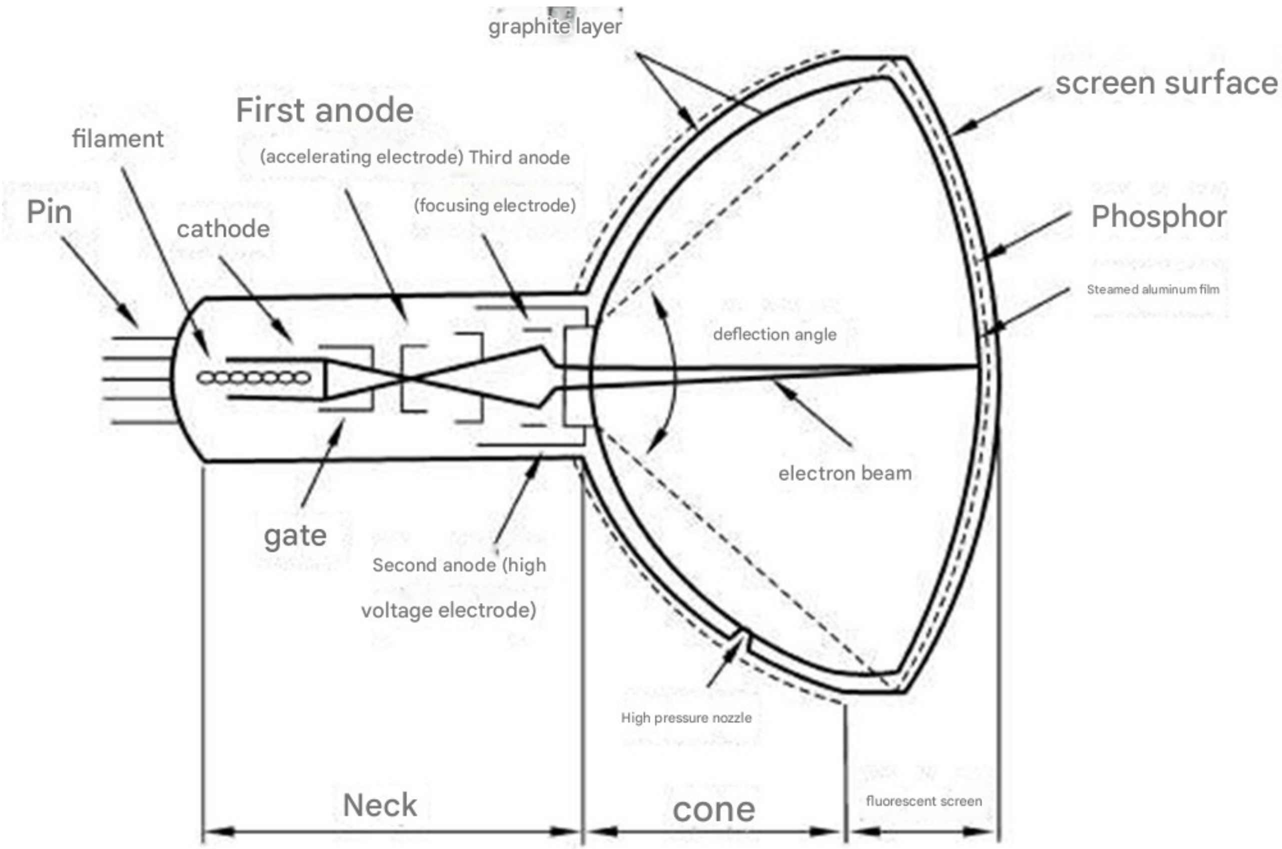


Figure 5-11 Schematic diagram of the structure of a picture tube

The tube can be divided into three parts: the tube neck, the cone, and the fluorescent screen. The electron gun is installed in the tube neck, which

consists of a filament, a cathode, a grid, a first anode (accelerating electrode) , a second

an anode (high voltage electrode) and a third anode (focusing electrode) .

The cathode is a small metal cylinder with an oxide that can emit free electrons on the top. The cathode cylinder surrounds the filament. When the filament is energized and heated, the oxide on the top of the cathode emits free electrons. These

free electrons form a very fine electron beam under the joint action of the accelerating electrode, the focusing electrode and the high-voltage anode. This electron beam is controlled by the magnetic field formed by the deflection current in the deflection coil on the neck of the

picture tube, producing a regular horizontal field scan. The grid is usually grounded. When a negative image signal is applied to the cathode, the grid is grounded.

When the electron beam is transmitted, the intensity is controlled by the image signal.

The same electron beam bombards the fluorescent screen according to the scanning pattern, thus restoring the image at the sending end.

The inner and outer surfaces of the tube cone are coated with graphite layers.

The anode high voltage is connected, and the anode high voltage is added from the high voltage nozzle of the cone part, rather than the pin part. This can reduce the requirements of the tube base material on the insulation performance and avoid the occurrence of breakdown. The inner

graphite layer can also collect the secondary electrons that may be generated by the screen under high-speed electron bombardment to prevent it from returning to the screen and causing

The outer graphite layer is usually grounded to prevent external electric fields.

Interference, thus forming a capacitance of thousands of picofarads between the inner and outer graphite layers, this capacitance is the filter capacitor of the high voltage anode.

On the outside of the tube neck

near the top of the cone, a The horizontal and vertical pairs of deflection coils share the same magnetic core, and a sawtooth current synchronized with the transmitter is passed through them, so that the same image as the transmitter is restored on the screen. The structural diagram of the deflection coil is shown in

Figure 5-12 . The position of the deflection coil is required and can be adjusted. The position of the deflection coil can be moved back and forth and rotated.

Make the electron beam form a rectangular raster on the screen without distortion.

A pair of permanent magnet rings, called center adjustment rings, are

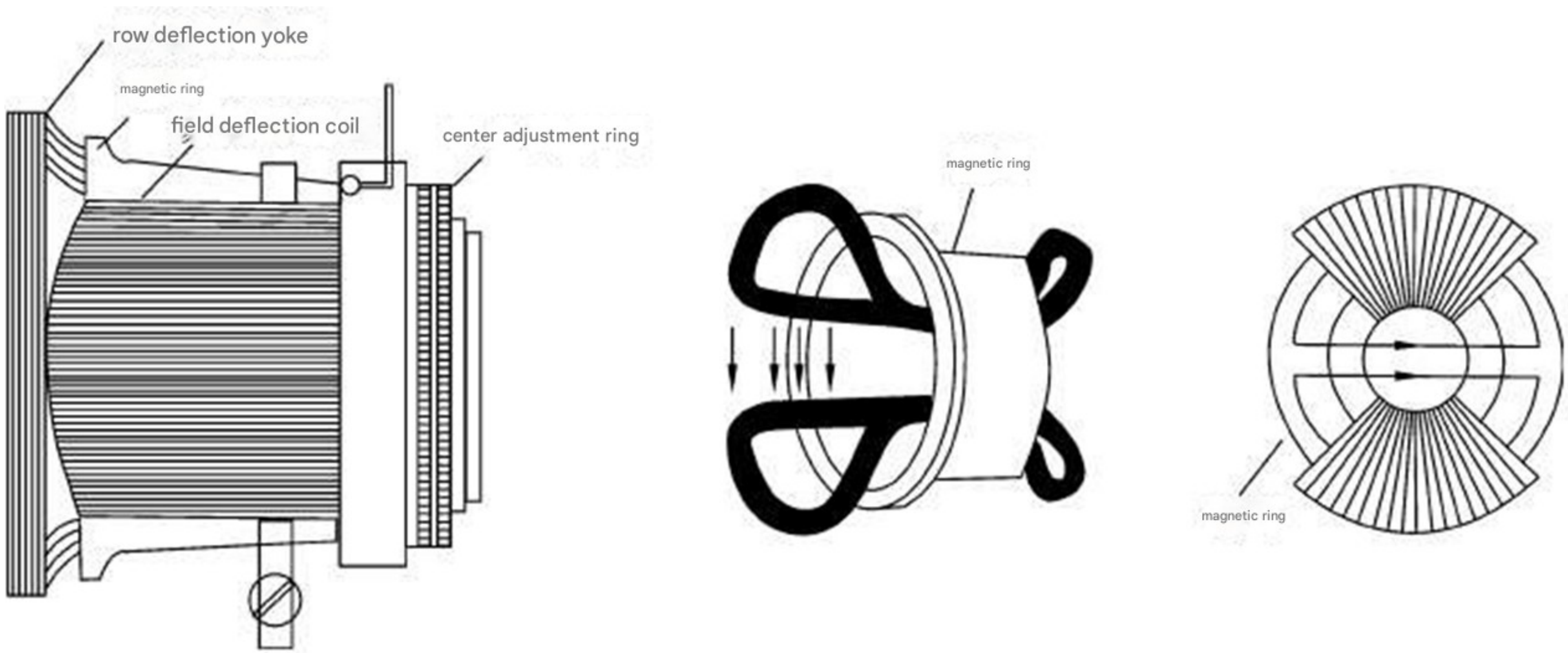


Figure 5-12 Schematic diagram of the deflection coil structure

installed at the tail of the deflection coil. By adjusting their relative positions, their synthetic magnetic field can make the center position of the grating consistent with the center position of the screen.

The total number of picture tubes for ZX2035 5.5 black and white TV sets

7 pins, and their arrangement order and functions are exactly the same as those of ordinary black and white picture tubes. Pins 1 and 5 are grids, grounded, so the voltage is 0V ; Pin 2 is the

cathode, and its voltage can be changed between 27 and 33V by adjusting the BRIG potentiometer ; Pins 3 and 4 are connected to the filament; Pin 6 is the accelerating electrode, with a voltage of about 120V ; Pin 7 is the focusing electrode, grounded, and the

voltage is 0V .

4. Brightness control circuit of picture tube

Imagine that when there is no TV signal, what effect does the DC potential of the cathode of the picture tube have on the strength of the electron beam? Since the control grid is grounded and has a potential of 0 V , the higher the

cathode potential, the weaker the electron beam and the darker the screen . The lower the cathode potential, the stronger the electron beam and the brighter the screen.

The potential determines the brightness of the fluorescent screen, so the so-called brightness

The control circuit is a DC voltage divider composed of a resistor.

Level adjustment circuit. In the schematic diagram, the 120V voltage obtained by the rectification and filtering of D14 and C56 is connected to the ground through the resistor divider composed of R61, BR1G

potentiometer, and R60. A path is formed from the upper end of the BR1G potentiometer to the protection resistor R51 of the cathode of the picture tube through a resistor R59 . The position of the center tap of the BR1G potentiometer can change the voltage applied to the cathode of

the picture tube.

The DC level adjusts the brightness of the picture tube.

5.10 Field Scan Circuit Analysis

The field scanning circuit of this machine is also divided into two parts. The small signal unit circuits are integrated inside CD5151 , and the field driving electrode and output stage with higher power are composed of discrete components. The following combines the whole machine electrical

schematic diagram 5-4 and the CD5151 internal circuit structure block diagram 5-2 to explain the working process of the field scanning circuit and the role of each component.

by the synchronization separation pole inside CD5151

The signal is directly added to the field trigger circuit, and after

processing, it is added to the field oscillator circuit to control the frequency and phase of the field oscillator.

The field oscillation signal generated by the field oscillator is consistent with the transmitting end.

It is directly added to the field

excitation stage for amplification, and

then output from the 26th pin of

CD5151 . At this time, the output is a

field frequency sawtooth wave signal,

which is sent to the base of the field

drive tube Q5 of the field output circuit composed of discrete components through C30 and R29. The external component R64 and potentiometer V - HOLD at the 24th pin of CD5151 are used to control and adjust the field oscillation frequency. From the schematic diagram, it can be seen that

the other end of V-HOLD is connected to the power supply circuit, and the power supply voltage is 9.1V . Therefore, it can be judged that R64 and potentiometer V-HOLD are the timing resistors of the field self-excited multivibrator. (V-HOLD

It is an English abbreviation, and its actual meaning is field synchronization adjustment and maintenance .

It can be seen from the printed circuit board that the potentiometer V- HOL D is installed on the back board for user adjustment. The capacitor C41 connected to the 25th pin of CD5151 introduces the feedback signal of the

field sawtooth wave. The potentiometer R P5 connected to C41 is used to adjust the field amplitude and field linearity. It can be seen from the schematic diagram that R P5 is both in a branch of the field deflection coil output loop and in the negative feedback loop. Therefore, adjusting the size of R P5 can

achieve dual adjustment of field amplitude and field linearity, which can be said to kill two birds with one stone .

Now, let's analyze the discrete components Q5 , Q6 , Q7 group .

The functions of each component in the field driving stage and the output stage.

If the field drive stage and output stage circuit composed of Q5, Q6, and Q7 are separated from the overall schematic diagram and drawn according to the customary method in

" analog electronics " , the customary layout of the electrical schematic diagram of the field scanning drive stage and output stage circuit will be obtained as shown in Figure 5-13 .

- **When the power is turned on, the regulated power supply outputs a stable 10.8V**

The voltage is filtered by R_{34} (1Ω) and C_{23} and then applied to the collector of Q_6.

Q6 and Q7 form a complementary power OTL amplifier circuit , R35 and R36 are

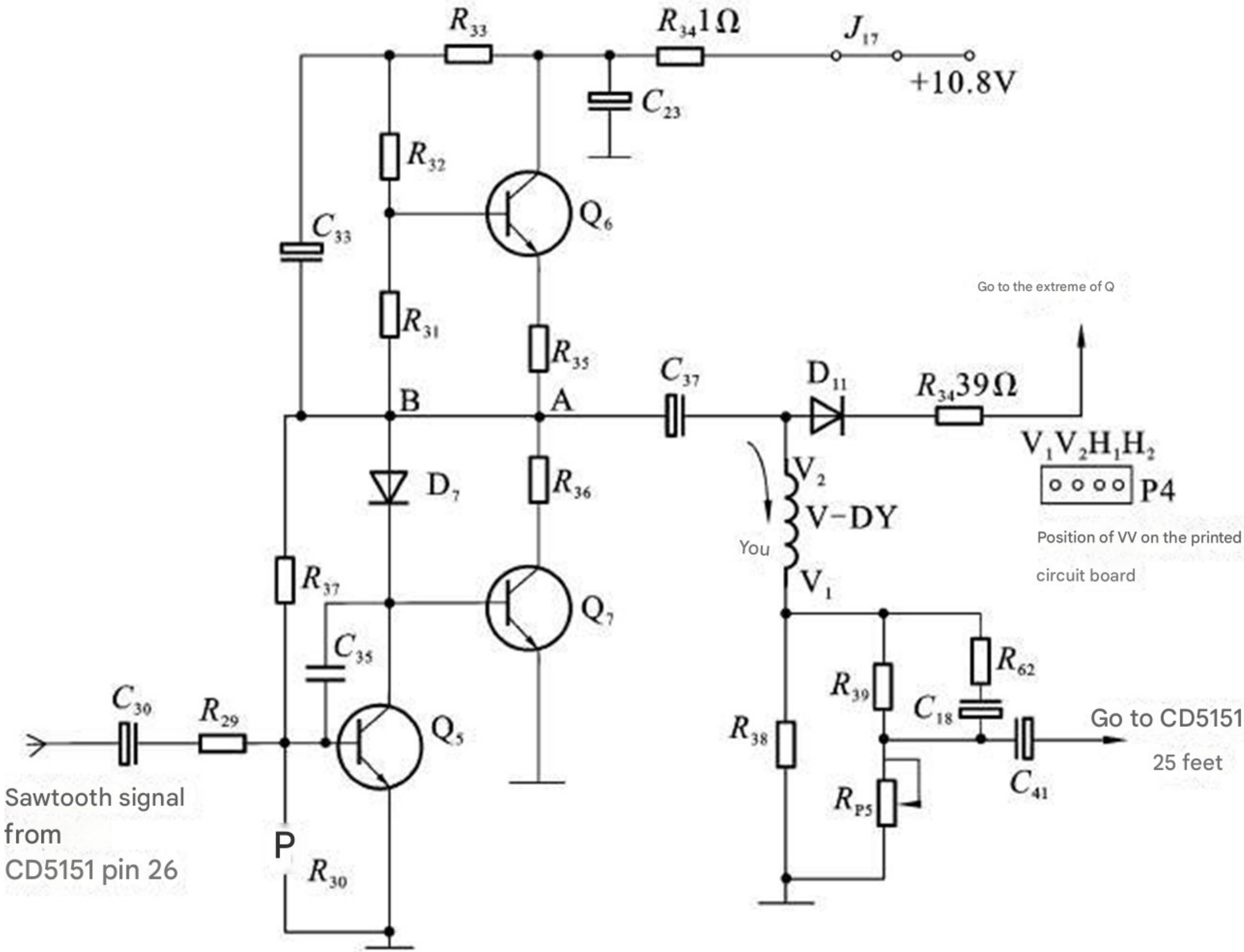


Figure 5-13 Field scanning output stage circuit composed of Q, Q., Q.

The emitter resistors (R35 , R36) can also be omitted, depending on the situation.

C33 is a bootstrap capacitor, R33 is an isolation resistor for boosting, R31 and D7 are micro - conduction clamping elements between the bases of Q6 and Q7 , R37 and R30 are base bias resistors of Q5, and C36 is a negative feedback capacitor to prevent self -excitation of

Q5. C37 is an output coupling capacitor and also a DC power supply when Q7 is turned on.

First, let's look at how the static operating point of each transistor is established.

The 10.8V DC stable voltage forms a path through R 34 → R 33 → R 32 →Q 6 be junction →R 35 →R 37 → Q 5 be junction → ground .

With the base-emitter current, the collector current will be generated.

This causes a path to be formed from R35 →R36 → Q7 's be junction → Q5 's collector . At the same time, R32 →R31 → D7 → Q5 's collector can also provide a DC current to Q5's collector. Since the be junction of Q7 passes the current , a path is also

formed at Q7 's collector. The voltage drop across R31 and D7 caused by the current passing through R31 and D7 is equal to the voltage drop across the bases of Q6 and Q7 .

When the voltage is in the state of conduction, Q6 and Q7 are in the state of conduction.

To overcome the crossover distortion of the complementary symmetrical power amplifier.

10.8V stable voltage also charges

C37 through the loop of Q6 , R35 ,

field deflection coil V-DY , R38 ,

making the potential at point A equal

to

$$\frac{1}{2} \times 10.8\ V = 5.4\ V$$

, so A the midpoint of the potential. point is

V2 and V1 marked at both ends of the field deflection coil in Figure 5-13 correspond to the letters V2 and V1 on the printed circuit board , indicating the position of the plug-in cable connecting the two ends of the deflection coil to the printed circuit board through the plug of the plug - in cable. The symbol of the

corresponding plug-in cable on the printed circuit board is P4 . Field deflection line

The lower end of the loop V-DY is connected to a parallel branch consisting of R 38 , R 39 , and R P5 .

It plays the role of limiting the deflection current and sampling feedback.

The sample signal is obtained on R P5 through R 62 and C 18 connected in parallel with R 39 , and sent to the 25th pin of CD5151 through C 41 , and returned to the inside of the integrated circuit, and compared with the field oscillation signal to realize feedback

control. At the upper end of the deflection coil, there is also a diode D 11 connected to C 37 , which introduces the reverse pulse of the field scanning current through R 34 (39Ω) to the emitter of the final video amplifier Q 8 to enhance the field blanking effect.

When the sawtooth voltage from CD5151 is applied to the base of Q5

When the current is

u_B , u_A of the e -pole of Q6 and the potential of the field deflection coil the current i_y (positive direction as shown in the figure) is shown in Figure 5-14 . Based on this waveform analysis, it is not difficult to deduce what kind of sawtooth waveform the base of Q_5 , that is, the 26th pin of CD5151 , should output. This analysis process is left to the readers to

complete.

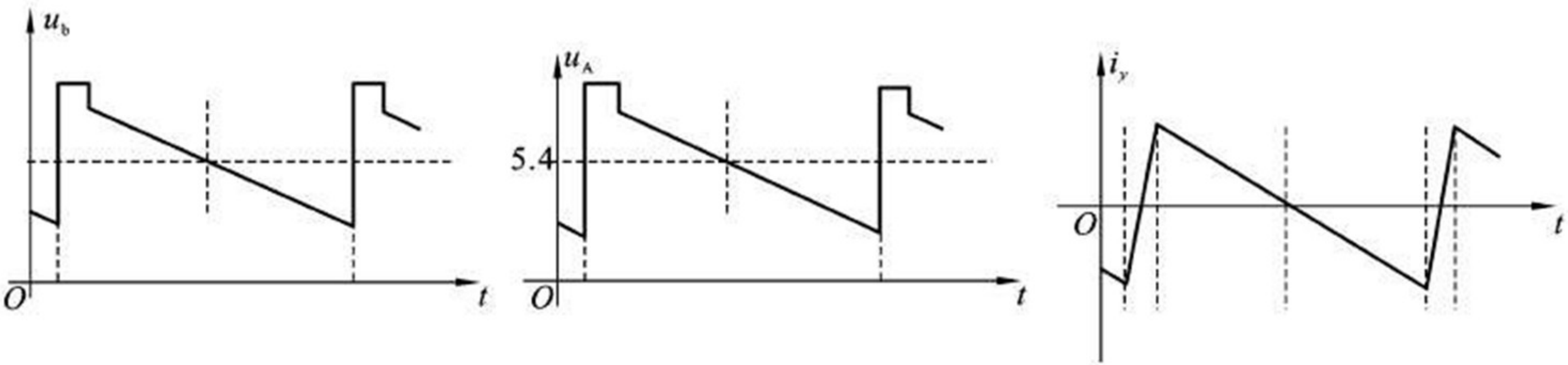


Figure 5-14 Field deflection current, forming a waveform

5.11 Audio channel analysis

from the ZX2035 schematic diagram 5-4 that after the frequency conversion circuit, the RF audio signal becomes the first audio intermediate frequency signal of 31.5MHz . It passes through the intermediate frequency amplifier and the surface acoustic wave filter together with the 38MHz

image intermediate frequency signal and enters the CD5151 . In the CD5151 , it is further amplified by the intermediate frequency. In the detection stage, the first audio intermediate frequency signal and the image signal are multiplied to obtain the second audio intermediate frequency signal of 6.5MHz . Therefore, the image signal detector is

equivalent to a frequency converter for the first audio intermediate frequency signal, and the sound signal is equivalent to a frequency converter for the first audio intermediate frequency signal.

The signal undergoes a second frequency conversion in the TV, so the 6.5MHz

The audio modulation signal is called the second accompaniment intermediate frequency signal. After this signal is output from the 5th pin of CD5151 , it passes through C17 and the 6.5MHz bandpass filter Y1 , and

enters the sound intermediate frequency amplifier SIF inside the integrated circuit from the 7th pin of CD5151 . The 8th pin of CD5151 is also a pin of the internal sound intermediate frequency amplifier SIF , but because its external circuit is connected to the AC bypass capacitors

C18 and C19 , the sound intermediate frequency amplifier SIF works in the single-ended input differential amplifier state. The resistors R17 and R18 between the 7th and 8th pins are the bias of SIF.

SIF amplification , the second audio intermediate frequency signal is sent to pin 9 .

The output is connected between pin 9 and pin 10 through the element T1 (a linear reactance transformer required by the internal peak frequency detector circuit), and then enters the integrated circuit from pin 10. The audio signal

obtained after frequency detection is output from pin 11, and is added to the third pin of the integrated circuit IC2, D386P through R20, C85, K1, R87, volume potentiometer 2RP1, C82 to amplify the audio signal . D386P , when its power supply voltage is 9V and the impedance of the load speaker is 8Ω ,

the output power can reach 0.7W . It is a dual in - line 8 - pin package . Pin 5 is the audio signal after the power amplifier

The output end is coupled to the speaker through C 87 to produce accompanying sound.

4 is grounded, and pin 6 is the power input terminal. The 10.8V regulated power supply of this unit is once again stepped down and filtered by R 83 and C 86 at the chip end to become a 9V DC regulated voltage for

the audio amplifier. JK3 is the headphone socket. When the headphone is inserted, the speaker will automatically disconnect. In the figure, C_{84} and R_{82} are high-frequency filter networks, while C_{88} and R_{84} are low-frequency filter networks.

5.12 Preparation before insertion and welding

And welding precautions

1. Before welding, you should read the electrical schematic carefully, understand the role and function of each component, compare the schematic with the printed board, and see where each component on the

schematic is on the printed board. You should also mark the corresponding positions of the 16 jumpers and the wiring sockets P1 , P2 , A4 , P3, and P4 on the printed board.

This can greatly improve your ability to read drawings and cultivate your ability to read schematics.

The ability to convert to printed circuit board diagrams will give you debugging and troubleshooting

It brings great convenience to work, thereby improving work efficiency.

When comparing the schematic diagram and the printed circuit board diagram, if any discrepancies are found, detailed records should be made. After confirmation, corrections

should be made to the errors and recorded.

Further, the printed circuit board diagram and the printed circuit board object should be

Comparison, of course, is a much easier task, but don't ignore it just because it is simple and easy. Any small negligence may bring serious

consequences, which has been proven by countless scientific practices.

2. Cleaning components

After checking the electrical schematic, printed circuit board, and printed circuit board, you can start cleaning the components, group each component according to the unit circuit it is in, and check whether each component is

qualified and whether the parameters are consistent with the schematic. After the inspection, each unit component should be inserted on a more original paper, marked, and placed in a plastic bag.

To avoid loss.

K2 used in this machine , the DC power supply

structures of DC socket , RF input socket ANTIN , frequency band switch K3 , AV /TV switch K1 , audio input socket JK1 , video input socket JK2 and headphone socket JK3, 2-wire socket P1, P2, A4, 4-wire socket P3 , P4 should be

carefully studied and researched . The solder joints in the real object correspond to which points in the schematic diagram and printed circuit board diagram . No mistakes can be made.

These components should be repeatedly measured, confirmed and memorized using an Ω meter.

3. Tips on some special components

（1） It is particularly important to remind you that the frequency band conversion switch K3 , as analyzed from the schematic diagram, is a parallel-moving double-pole three-throw conversion switch, but it is used as a single-pole three-throw switch to increase reliability. This component

must be tested repeatedly with an Ω meter in advance to clarify which contacts are the knife and which contacts are the throw.

(2) Note that the arrangement order of the high frequency tuner pins is as follows

To be sure: turn the side with several trapezoidal pits toward you, with the pins facing upwards, from left to right,

they are 1 to 10 pins.

（3） For the power supply regulator Q2 ,

The side marked with the model number faces you, the heat sink side faces backwards, the left foot is the base, the middle is the collector, and the right is the emitter. It is best to retest with a multimeter.

（4） This machine uses 10 transistors of 5 different types .

You need to be able to use a multimeter to identify their e , b , and c poles, and install different colored sleeves for easy identification.

（5） This machine uses two different models with different voltage regulation values.

The voltage regulator diode should not be confused when using it, and it should be correctly judged

Their pins and voltage regulation values.

（6） This machine also uses 11 diodes of five different types . Again, be careful not to mix them up, and use a multimeter to correctly determine the pin functions.

4.Insertion and welding

（1） When installing the transistor , 6 to 7 mm of pins should be left , the C pole should be covered with a 4mm red plastic sleeve, and the B pole should be covered with a 4mm green sleeve. The sleeves and the pins should fit

tightly and not be loose .

（2） When installing the diode, keep it 2 to 3 meters away from the printed circuit board.

mm distance, the same applies to high-power resistors, such as OR2 , to facilitate heat dissipation, and the remaining components can be

installed close to the printed circuit board.

（3） The power supply section's adjustment tube Q2 and heat sink

To insert the PCB vertically, after the heat sink is inserted into the PCB, the protrusion should be twisted at an angle so that the heat sink can be

clamped on the PCB.

（4） Q_2 and radiator, high frequency tuner,

The output transformer should be installed last in each unit.

（5） To prevent damage to the integrated circuit during soldering,

This machine is equipped with 2 IC sockets, just need to solder the sockets.

（6） Insert the CRT socket printed circuit board onto

the CRT

Or when unplugging, apply force parallel to the direction of the tube pins. Be careful to avoid breaking the seal on the back of the tube and causing air leakage in the tube. Try to

reduce the number of plugging and unplugging times.

5.13 Debugging and assembly

1. Preparation before commissioning

Before debugging, you should be familiar with the positions of the potentiometers, sockets, switches, jumpers, wiring sockets, and step-down filter resistors of each power supply circuit on the printed board.

A row of components under the printed circuit board. After the final assembly is completed, they are

The back of the TV, from right to left:

（1） ANTIN socket, for external CCTV plug;

（2） DC socket, used when connected to an external 12V DC power supply;

（3） JK_1 and K_1 are turned to AV , it is the audio signal input socket;

（4） JK_2 and K_1 are turned to AV , they are the video signal input sockets;

（5） K1 , AV , TV selection switch ;

(6) V-HOLD , 33KΩ field synchronization adjustment

potentiometer;

（7） BRIG , 1MΩ brightness adjustment potentiometer;

（8） CONT , 2KΩ contrast adjustment potentiometer;

A row of components on the printed circuit board from left to right (if the final assembly

Once completed, they are on the front panel of the TV (from right to left when looking at the front of the TV):

(1) K2 , power switch;

(2) 2R P2 , electrical tuning potentiometer, used to select different

channels;

(3) K3 , frequency band selection switch, can be placed in three different positions, respectively selecting VL , VH , and U frequency bands;

(4) 2R P1 , audio volume control potentiometer;

（5） JK 3 , headphone jack, for external headphones.

are four trimmer resistors (potentiometers)

by technicians to adjust the TV before leaving the factory or during maintenance . They are installed in the corresponding positions on the printed circuit board. During normal use, users cannot adjust them. The four fine-tuning resistors are:

（1） RP4 , voltage regulator output

voltage adjustment potentiometer, adjust

the R_{P4} unit should be able to vary within the range of 9 to 12V and can be adjusted to 10.8V ;

(2) R_{P5} , is used for field linear regulation;

(3) R_{P7} is used for line frequency adjustment;

（4） R $_{P1}$ is used to adjust the RFAGC delay amount.

2. Debugging method and sequence of the whole machine

There are two ways to implement soldering, debugging and assembling TV sets. The first is to solder one unit circuit, that is, to test and debug one unit circuit. After debugging one unit

circuit, solder, install, test and debug the next unit circuit until all the unit circuits are soldered, installed, tested and debugged . The second is to solder all the unit circuits at once.

Do not solder the jumper wires or filter voltage drop resistors yet.

After the circuit is tested, solder it before powering on. However, no matter which method is used, the debugging sequence of each

unit circuit must be carried out in the following order:

> **Regulated power supply circuit → horizontal scanning circuit → field scanning circuit**

Scanning circuit → final stage video amplifier circuit →

intermediate frequency amplifier circuit → synchronous separation circuit → accompanying sound circuit.

3. Static test of unit circuit

For each unit circuit, after welding is completed and before power is turned on, you can use the Ω range of the digital multimeter to perform a static test to check whether there is a short circuit or other faults in the circuit, as shown in Figure 5-15 . Select the appropriate Ω range of the digital multimeter and use the red

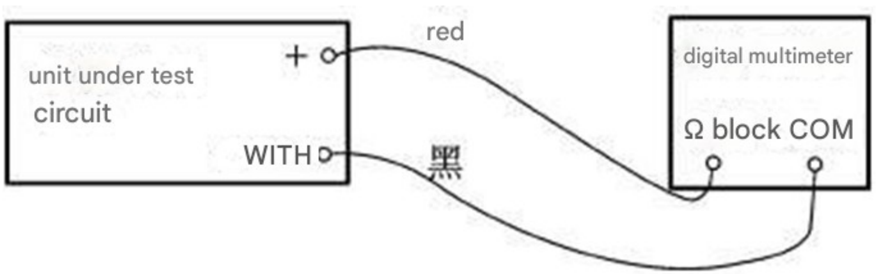


图 5-15 Use the block to measure the input resistance of the unit circuit (when the power is off)

The test lead (connected to the positive pole of the multimeter battery) is connected to the power input terminal of the circuit under

test.

The black test lead is connected to the common ground.

Because the power input terminal of the detected unit circuit is generally connected to a large capacitor

The amount of filter capacitors, so

when the multimeter is just connected,

the resistance value displayed will be

very small, then it will gradually

increase, and finally stabilize the

displayed value, which is basically the

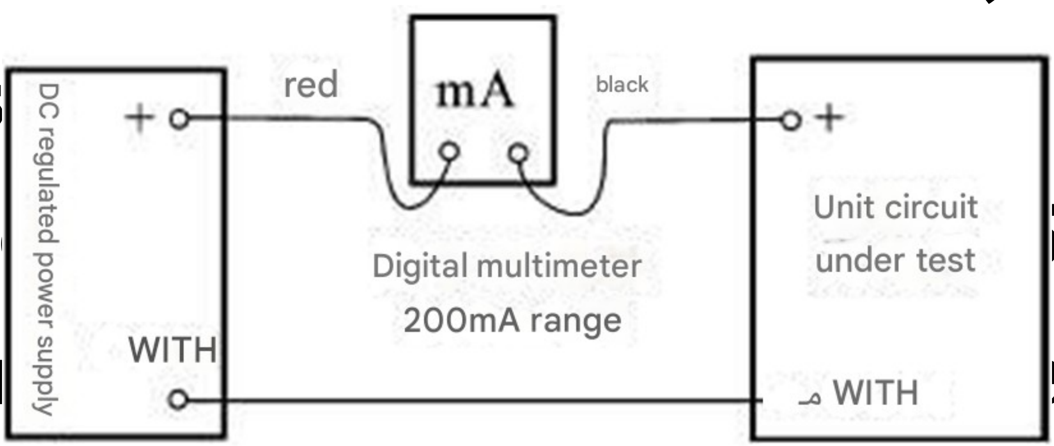
input resistance of the unit circuit, from which the current drawn by the unit circuit can be estimated. If it is within the normal value range, it can be powered on for debugging. If necessary, the static working current of the unit can be further tested. As shown in Figure 5-16 , set the

ammeter to the maximum gear and connect it in series in the circuit. After the display is normal, set the ammeter to the appropriate gear to measure the static current of the circuit when it is normal.

The static current test must be done at a regulated voltage.

It is carried out after the road debugging is completed and the work is normal.

If there are problems with the above two static tests, for example, the



s circuit under

t Ω , this is

i current

c machine is

Figure 5-16 Static operating current of the measuring unit circuit

only 1.2A , the input resistance is 5Ω , and the

reaches 10.8V , the current will reach more than 2A . How can the road be consumed?

So, normally, it is Impossible. There must be some abnormal situations such as partial short circuit or wrong connection of components. You should carefully recall what mistakes you may have made in the

welding process and be sure to check and eliminate the faults until you pass the static Ω test and current test.

4. Debugging of DC regulated power supply

First, perform a static test on the unit circuit of the DC regulated power supply. Do not solder the jumper J17 and resistor OR2 yet . At this time, the DC regulated power supply circuit is

independent and does not supply power to any unit circuit of the machine because the two main power supply lines are cut off. Use a digital multimeter with a high resistance value in the Ω range to measure the resistance. Connect the two test leads to the

two terminals of the two-row socket P1 .

Because the transformer is not connected at this time, so normally,

The resistance value should show infinity or overflow. Then move the red test lead to the DC

The black test lead is moved to the ground end, and the multimeter should also display overflow or infinity. After the static test is normal, you can plug in the P1 plug, connect the transformer, and then plug in the AC power plug, pass AC power, and use

the DC voltage range of the multimeter.

(greater than 15V) monitor the output voltage of the regulated power supply, adjust R $_{P4}$,

Make the output voltage 10.8V . Now, various performance indicators of this voltage regulator can be tested, such as output voltage adjustment range,

output resistance, voltage regulation rate, ripple, etc.

5. Debugging of Line Scanning Circuit

the static Ω value of each unit circuit is normal and the static current is normal, the TV should basically work normally, such as scanning lines appearing on the screen and the speakers making noises. However, it is necessary to check and debug each unit circuit

accordingly to put the TV into the best working state.

First debug the row scanning circuit, because the row scanning circuit

The output transformer is the second-level power supply unit, so it should be debugged first. At this time, the regulated power supply

should be supplied to each power supply circuit of the machine.

of the output tube Q10 should be

12V , the voltage of pin 17 of CD5151 should be between 0.4 ~

1.2V , you can observe the voltage between 1.2V and 1.2V at pin 17 with an oscilloscope.

15625HZ pulse square wave.

Since the machine is powered on, the scanning line should appear on the screen under normal circumstances. If the line scanning is unstable, try fine-tuning R_{P7}.

6. The first thing to check when debugging the field scanning circuit is

Is the node voltage where the five components R35 , R36 , R37 , C37 , and C33 intersect? Is it half of the output voltage of the regulated power supply, 10.8V, which is about 5.4V ? Secondly , detect the DC potential of the 24 , 25 , and 26 pins of CD5151 , and make a

record. Adjust the field frequency potentiometer V-HOLD to make the grating flicker and disappear (when the field frequency is too high or too low, the grating will flicker. When the field frequency is accurate, the flicker will disappear). Fine-tune the field linearity and field amplitude potentiometer R P5 to make the field scan fill the entire screen. If

necessary,

An oscilloscope can be used to observe the waveforms of pin 26 of CD5151 and the cathode of D11 .

7. Detection and debugging of the auxiliary circuit of the picture tube

The auxiliary circuits of the cathode ray tube include the final video amplifier, the horizontal and vertical deflection circuit and the brightness adjustment circuit.

First, the voltage of each pole of the cathode ray tube should be tested,

and the 6th pin should be 120V The third pin should be AC 6.3V . The high voltage anode cannot be detected by ordinary multimeters, so it is generally not necessary to measure it. Adjust the brightness control potentiometer and measure the DC voltage of the second pin at the same time. It should be able to

change within 10 to 80V . Move the magnetic ring behind the deflection coil and watch the changes of the scanning grating on the fluorescent screen to make the grating in the middle position. If

When there is no grating at the four corners of the picture tube, the deflection line

Push the deflection coil to the bottom in the direction of the cervical spine. If the grating is tilted, you can rotate the deflection coil to make it straight. Adjust the brightness potentiometer so that the grating is brightest to meet the needs of daytime viewing, and the

scanning line has no obvious defocus. The screen should be completely black at the darkest. If the brightness is not controlled, check the brightness control circuit. If the image appears upside down, swap the two leads of the field deflection coil. If it is reversed left and right, swap the two leads of the line deflection coil.

8. Signal channel detection and debugging

The signal channel includes five parts: high-frequency tuning circuit, intermediate frequency amplifier circuit, video amplifier circuit, synchronous separation circuit, and audio circuit. Since the machine uses surface acoustic wave

filter to control the frequency characteristics, the frequency characteristics do not need to be debugged. Adjust the channel selection potentiometer 2 R_{P2} and monitor the voltage of the high-frequency tuner pin 4 should change between 0 and 33 V. Detect

high-frequency tuning

The voltage at pin 8 should be around 10.8V .

The voltage of each electrode should be: base 1.15V , collector 8V , emitter

too large , the corresponding

circuit should be tested. Set the

high-frequency tuner to an empty

channel, use a multimeter to

measure the voltage values of pins

1 , 2 , 3 , 4 , 5 , 14 , and 15 of

CD5151 , make a record, and compare it with Table 5-1 to verify the correctness of the data. Adjust the channel selection potentiometer 2R $_{P2}$ to make the TV receive a signal from a certain channel, and use a multimeter to monitor the voltage .

CD5151 5 - pin voltage, use a plastic screwdriver to fine- tune T2

The magnetic core makes the voltage of pin 5 the lowest. At this time, the output signal of pin 5 is the highest.

Strong, while watching the screen effect, is it the best. Some movement T2 has been made into a fixed type, so this item does not need to be adjusted. Detect the

voltage of each pole of the final stage video amplifier Q8 , the B pole should be 3 ~ 4V , the C pole should be 80V , and the E pole should be 3V . If the deviation is too large, the corresponding circuit should be checked. When the image appears to be unstable

when rolling up and down, the field synchronization potentiometer V-HOLD can be fine-tuned .

9. Detection and debugging of audio channels

First, check the voltage values of pins 7 , 8 , 9 , and 10 of CD5151 and make a record. After receiving the TV signal, fine-tune the core of the 6.5MHz intermediate frequency T1 connected to pins 9

and 10 to make the accompanying sound clearest and the noise minimum. Check the voltage of pin 6 of IC 2 , i.e. D386 , which should be around 9V . If there is no accompanying sound, other audio signals can be directly sent to the audio input socket JK 1.

Amplify with an amplifier to see the effect. Signal tracing method can also be used

Check the fault. Check the image signal channel

A similar method can be used to directly input video signals from the video signal input socket for inspection. It should be

noted that when using JK 1 and JK 2 to directly input audio or video signals, the AV/TV conversion switch must first be turned to AV gear.

10. Final Assembly

After debugging and testing, you can proceed to assembly. First, install the transformer and speaker in the corresponding position of the upper cover. The transformer is fixed to the right side of the

upper cover with Φ 3.5 × 15 self-tapping screws, and the speaker is installed on the left side of the upper cover. There is a slot on the left side, and the speaker can be inserted. The power switch is equipped with a plastic button, volume

potentiometer 2 R_{P1}, and electric tuning

Install the knobs on potentiometers 2RP2 AND 2RP3.

Insert it into the slot of the front cover and fix it with Φ 3 × 12 self-tapping screws. All the shells have been

installed before leaving the factory. Before disassembling, you can carefully read the specific installation method. During the disassembly process , make notes while

disassembling. When reinstalling,

Chapter 5 Homework